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CONTRIBUTIONS.—Subscribers and others will materially assist in making our news accurate and complete if they will send early information of events which take place under their observation. Discussions of subjects pertaining to all departments of railroad business by men practically acquainted with them are especially desired.

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Interstate Commerce Commissioner Cockrell says that the Commission will aim to secure:

> "(1) A uniform system of accounting by the railroads; (2) a uniform system of classification of freight throughout the United States; (3) a uniform schedule of rates, fares and charges; (4) the performance by the roads of the entire transportation service from the place where freight is received to the point of destination."

The first, third and fourth of these objects are in most of their features new, and their accomplishment is a more or less legitimate object of endeavor by the Commission and of discussion by anybody; but the second problem, which means, we suppose, subject to a reasonable number of exceptions, to put each commodity in the same class everywhere, is fifteen or twenty years old. Has the revision of the law in any respect changed the conditions surrounding it? We cannot see that it has. If the Commission were empowered to establish rates by wholesale, without waiting for a complaint, as may be done by the Texas Commission, for example, a rigid classification, to apply everywhere, would be easy. Moreover, we may say, in passing, that a rigid classification, enforced by fiat by an arbitrary and all-powerful Governmental agency would be free from some of the drawbacks that have made it impossible for the railroads to agree on a classification. The inability of the railroads to agree has been due, not alone to the unreasonableness and injustice of the changes that would have to be made in one territory to make its freight classes agree with those of another territory, but largely also to the impossibility of clearly explaining to shippers many changes that would be practicable and possibly beneficial. A railroad must not only give fair rates, but must do its best to convince the customer of their fairness. A Government board would be largely relieved of this duty—or, at least, the board would be so distant and lofty, as related to many aggrieved shippers, that complaint would be difficult and the turning of a deaf ear by the Commission would be easy. But the new law does not give any such sweeping power as a change of classifications would necessitate. Changing a classification is prescribing rates; and the Commission can prescribe rates only after a regular complaint and full hearing. To unify the classifications between New York and San Francisco it would be necessary to change the class of, say, from ten to a hundred important commodities; and each change would cause loss either to a railroad or to a shipper. Even if a reduction forced on a carrier were uncomplainingly submitted to by him, the change would in many cases give rise to complaints from shippers of other and competing commodities not reduced. Thus the Government would be forced into the same position that the railroads are in now: forced often to hear a complaint of excessive rates which has more or less basis of reason but which cannot be adjusted because a reduction would cause a lot of other rates to tumble down at the same time. A change in classification being, therefore, such an intricate operation, who is going to make the complaint, or bunch of complaints, that would be necessary to warrant the Commission in taking the subject up for consideration? There would be complaints a-plenty after the change had been made; but beforehand each complaint—assuming that there were one or more aggrieved shippers to make complaints—would have to be dealt with on its merits; merits which would be different from, and probably would conflict with, the merits of other complaints. In short, the demand for uniform classification is, in substance, little more than a demand for a simplification of clerical details, while the rate-regulating machinery which Congress has put into the hands of the Interstate Commerce Commission is designed to deal with demands of an entirely different nature—demands for radical change in the substance of things. The classification is little more than a mechanism for applying rates; the making of rates is a radically different operation.

At last one of the party (Democratic) conventions in Connecticut has adopted a platform that criticizes, all too briefly, the state railroad commission, yet the Hartford *Courant* expresses some wonder that the particular commission should have been singled out for censure. Its party opponents ought to be able to dispel the wonder of the *Courant* very quickly. The creative statute of the state of Connecticut provides for a railroad commission of three members at an annual salary each of $3,000 a year—paid by the railroad corporations—and free transportation on railroads and

street railways for themselves and all persons in their official employment. One of the three members must be a lawyer; another a civil engineer, and the third a "practical business man." The commission now consists of a civil engineer about 72 years old who, since he was appointed to the commission in 1887, has given up, we understand, active practice of his profession during a long period of high and rapid development in railroad engineering. Both the other two commissioners have been chairmen of the state committees of their political party in Connecticut—one of them reaching the inverted dignity of a "boss"—both have had long and active records in the legislative lobby and neither of them, before appointment, had any training in railroad matters. The commission has been vested with ample statutory powers even larger than those of the efficient commission of Massachusetts. But it has exercised those powers only in the most negative fashion; it has never had initiative or a policy; it left to the action of a private citizen the printing of the street railway returns after the returns had been ordered by the legislature; on general railroad and railway legislation it has exerted practically no influence either formative or advisory; and, as we have in past years pointed out, its compilations of figures and summaries have contained blunders that would be farcical in a Connecticut common school. Under the statutes of the state the commission could easily enough have checked trolley inflation in Connecticut, yet it has allowed that inflation to reach about $100,000 per mile of capitalization—stock bonds and floating debt—or about double the amount in Massachusetts. By tradition and custom the commission was for many years partisan, with two members representing the dominant political party, but last year it was made absolutely partisan. Partisanship, incompetence, indifference and sinecureism are hard words to apply to an old board of railroad commissioners in an eastern state; but in Connecticut they have been richly earned and challenge the platform criticism of both political parties rather than of one; and, unfortunately, the Connecticut commission represents a type too common in the country at large with demagogism often added to the other traits of negation.

It was definitely announced this week that negotiations were in progress between Messrs. Kuhn, Loeb & Co. and the Union Pacific Railroad Co. for the sale to the Union Pacific of the 400,000 shares of Baltimore & Ohio, which the Pennsylvania recently disposed of. At the time of the Pennsylvania sale a few weeks ago we called attention to Mr. Cassatt's statement, in which he said that the Pennsylvania originally took the Baltimore & Ohio stock because the road was making trouble, but that he was convinced that it was now going to be good. The Union Pacific wants the stock for quite a different purpose from this. With its main lines terminating at Omaha and at Kansas City, it has had no eastern connection of its own, although it has worked in harmony with the Chicago & North-Western and with the Vanderbilt lines for many years. Suppose, however, that the Chicago & North-Western intends to use the large issue of stock to be asked this fall, for purposes unstated, to push through to the coast. The North-Western would then become a rival instead of a friend, and it may conceivably have been forced home to the Harriman interests that their eastern territory and eastern connections are in jeopardy. More important, however, than the Chicago & North-Western extension funds are the moves which the Goulds are making to have a transcontinental line of their own, the first true transcontinental line between the Canadian Pacific and the National Tehuantepec road, the former crossing the continent with a span of 2,904 miles, the latter with a span of 193 miles. The Goulds are rapidly pushing the Western Pacific connection between the Pacific coast and the terminus of the Rio Grande Western. They have their Pittsburg entrance and their Western Maryland and West Virginia Central & Pittsburg, and lack not much over 100 miles of having an absolute transcontinental line under one flag. It is true that the prospects for their filling this gap through the extremely mountainous country lying between the Wheeling & Lake Erie and the West Virginia Central & Pittsburg are not especially immediate; competition is intense and the finances are in pretty bad shape, but the possibility is there, and the link will doubtless be built some day. Through the medium afforded by its holdings in the Chicago & Alton it may be fairly said that the Union Pacific, on the consummation of its Baltimore & Ohio purchase, will come measurably near to having a transcontinental line. From present advices it looks as if it would own something more than a fifth of the entire Baltimore & Ohio stock outstanding; not a large proportion, it is true, and yet enough to give it a considerable voice in the management of the company, especially in consideration of the fact that the Baltimore & Ohio has fully as much to gain as the Union Pacific has by through traffic arrangements.

FOREIGN CAR WHEEL PRACTICE.

The present unusual demand for freight equipment is not confined to the United States, heavy orders having recently been placed by Italy, Belgium and other European governments. The requirements include all classes of cars of the usual foreign type; steel underframe with wooden floors and superstructure, the capacity varying from fifteen to twenty metric tons carried on four steel-tired wheels. The delivery of the cars is limited, in most instances, by the ability of the contractor to secure these wheels. A few builders make their own, but the majority purchase them along with the axles, from some German or Belgian steel manufacturer. Many of these steel makers are in turn dependent upon the tire makers, and some even purchase the centers as well, assembling and mounting the parts only. The process of manufacture is unavoidably slow and expensive, at best.

Why do our neighbors continue the use of these wheels, when a chilled iron wheel is not only less expensive but much easier to produce? The chilled cast-iron wheel came into use in the United States at a most opportune time, the first expansion period both of the country and of the railroads, and has proved to be at once cheap and efficient. Chilled wheels are so easy to make that their use has enabled the railroads to obtain large numbers of cars on short notice, while their low valuation has reduced the investment. The eight wheels under an American 40-ton freight car represent an investment equal to less than that necessary for two wheels of the European type used under a 20-ton car. This means for us a smaller investment in rolling stock per ton carried, and either reduced freight rates or increased earnings, or both. The wheels can be made in almost any foundry, and the annual production runs into the millions. Any manufacturer can control his output absolutely, and is not dependent upon some steel combination for tires, centers, etc. Give him the raw material and he will deliver the wheel. When the history of the development and economies of American railroads is written, the chilled iron wheel should be given an honored place, its low initial cost, ease of manufacture, efficiency and high scrap value has rolled up many a dividend which would not have been possible after the investment required by the use of steel tired wheels. Now that our equipment is becoming permanent and of higher capacity, the chilled wheel may possibly be relegated to secondary services, but let us not forget its past record.

There are several reasons why this wheel has never been used abroad, not the least being an old prejudice against the use of a casting where its failure might produce a wreck. There exists in most countries a law forbidding the use of cast iron for wheels. No one is interested in agitating the repeal of these laws, for the officials now serving found the steel tired wheel in satisfactory use when they came into office, and why should they run the risk of losing position and reputation by adopting something else? If the change proved a success they would reap no benefit, whereas one wreck traced to a wheel failure would carry with it the resignation and reputation of the sanctioning official. Moreover, since many foreign roads are owned by governments, which fix freight rates by law, the matter of reduced investment is not important. The shipper is accustomed to high freight rates, and is not influential enough to persuade the government to change its practice and give him the benefit. Then again, the European standard car wheel diameter is much larger than ours, averaging about one meter. Would the chilled iron wheel prove as efficient at this diameter as it has at 33 inches? It would be difficult, if not impossible, to reduce the diameter under the existing four-wheel equipment without serious expense, so until the double truck, permitting the use of a smaller wheel, is adopted, there is little chance of its introduction. It is true that Austria and Hungary use the chilled wheel to some extent, but cars so equipped are not accepted for interchange by other countries. Chilled wheels have also been used successfully in Spain on narrow gage roads not subject to the same laws as those of standard gage.

Some time this fall representatives of the different countries which interchange cars will meet at Berne to discuss and adopt standards. Could they be persuaded to sanction interchange of freight cars equipped with the chilled wheel it would undoubtedly lead to a more general use of this wheel in Europe, but until

some move of this sort is made the governments will have to be content with slow equipment deliveries as well as heavy initial expense and investment.

REFRIGERATOR CARS FOR THE HARRIMAN LINES.

Announcement is made in our news columns this week that the Harriman lines have ordered 6,000 refrigerator cars from the American Car & Foundry Company. At $1,200, which is about what these cars will cost, this is a $7,200,000 contract, and noteworthy for that reason if for no other. But the wholesale purchase of refrigerator cars by a company which has hitherto relied on the Armours raises interesting questions of policy, covering an area much greater than that served by the lines extending from the Pacific coast to New Orleans and Omaha. The new law provides, subject, of course, to judicial interpretation, that railroad companies are under obligation to supply their customers with refrigerator cars when necessary. Heretofore the Armour interests, through their peculiar double possession of a highly desirable kind of tonnage and of refrigerating equipment, have been able to drive hard bargains. It was always obvious that if the roads in a certain large territory should get together and refuse Armour equipment, they could regulate the situation, but the cost was great, competition was keen, and there remained the fact, constantly recurring in testimony, that most railroads had light seasons and heavy seasons for the use of refrigerating equipment, so there was real economy in being able to obtain this equipment for a season as long or as short as the case might be, and then dispense with it. It was cheaper to pay three-fourths of a cent a mile for refrigerators at the height of the season than to maintain the cars and pay the interest charges on them the year around, especially in view of the fact that any company which manifested hostility to this arrangement would receive no Armour beef shipments. This was very well if cars could be gotten, even if the rates had to be hammered down to the minimum. But it happened most frequently, especially in the case of smaller roads, that the supply of refrigerator cars was not equal to the demand, while the icing charges remained a constant source of dissatisfaction to the shipper. All this matter is of so recent record, however, that it need not be further discussed.

The new Harriman order is apparently equal to nearly fifty per cent. of the total number of Armour cars. The road has therefore declared its independence with a vengeance, along with the Atchison, which has used its own refrigerator equipment, apparently with entire success, for a number of years. Whether or not these precedents can be generally followed is another matter. The orange, lemon and vegetable business in Southern California amounts to some 25,000 or 30,000 carloads annually, and there is a two-season demand for equipment, deciduous fruit moving in the summer months and citrus fruit in the winter. Thus the Southern Pacific has an unusually long demand for refrigerator cars, but must, nevertheless, be exposed to dull seasons in between, although beef traffic on the Southern Pacific and Union Pacific alike can doubtless furnish a use for some of the cars. But in Georgia, in Michigan, and other localities where the season is short but the demand urgent, conditions are quite different. Whether the Harriman lines propose to rent out their equipment between seasons, we do not know; there would surely be nothing impossible in the formation of some such arrangement, without the traffic strings tied to it which gave the Armours their dictatorial power. In any case, the new increase in the total amount of refrigerator rolling stock in the country, and the independence of the central and southern group of lines to the coast, should temporarily at least make the supply fully equal to the demand if not in excess of it, and thereby lessen the difficulties of the smaller roads.

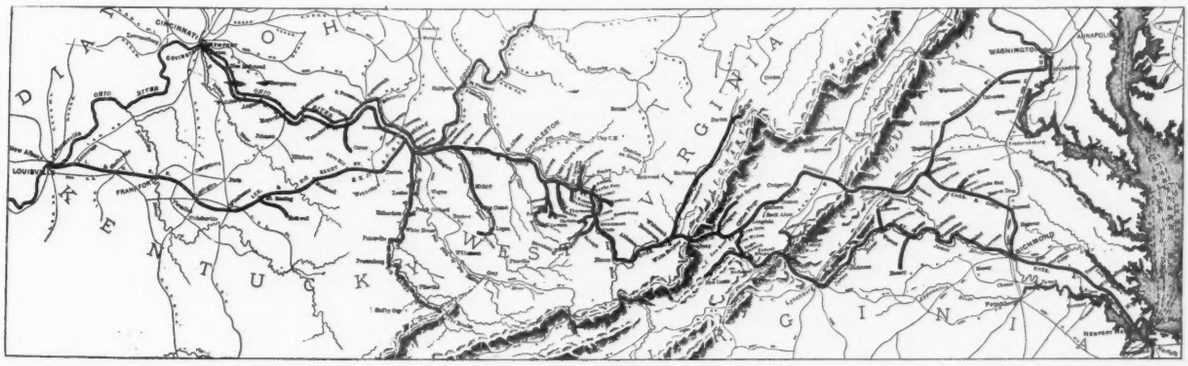
What the final outcome will be, whether the Armour equipment will be sold, or part of it sold, can only be a matter of conjecture. It is evident that there is a real need for a flexible system of refrigerator car distribution, and the private car companies can render a great service to the railroad companies, under the supervision of the new law, with the old flagrant abuses checked, and enough competition to shift the balance of demand.

On a branch railroad of one of the largest systems of the country having a regular passenger rate per mile there is a small station erected by a private citizen but on land owned by the railroad corporation. The station is not marked on the local time-table of the branch line either as a "flag" station or by any other title whatsoever; but by "custom," especially during the heavier summer passenger traffic, local trains stop either when passengers appear on the station platform or on notification to the conductor when passengers wish to alight. Not long ago at the terminal station a party of three persons asked for tickets to the *quasi* "private" station. With no tickets supplied to the station in question the ticket agent attempted to charge to the next station several miles beyond for which the tickets were on regular sale. Payment was refused and the matter was finally compromised conversely by sale of tickets to the station next *before* the party's destination. Nor did the case end here: The conductor, though duly notified, carried the party three-quarters of a mile beyond their station before remembering to stop the train and an important appointment—it might have involved a large pecuniary sacrifice—was missed. We cite this whole case, with its actual facts coming to our attention, as a sample of the small but sometimes costly complexities which railroad corporations face in the operation of rural lines with their little and what we may dub "hybrid" stations. Here in this petty instance were raised questions of official instruction, of the legal status of a hybrid station privately erected on corporation land, of the proper adjustment of fare, and of responsibility, in such a peculiar case, of the corporation for the act of a forgetful conductor—all large matters of legal principle and procedure. The practical aspect of such a matter is the perilous unwisdom of the irregular railroad station unclassified and ranking below the "flag" station; and, secondly, as regards at least formal title to all stations, the importance of unmixed and responsible corporative ownership. The thousands of flag stations in the country, with their incubus on conductors in the gloom of fog and darkness, are enough without ramifying into a lower scale with higher risks.

Chesapeake & Ohio.

The Chesapeake & Ohio has had a year of large and steady growth. Gross earnings, which a year ago showed what was then held to be the important increase of $1,400,000 over the 1904 twelve month, have during the past year made a further gain of over $3,800,000, and net earnings, following an increase of $959,000 in 1905, last year made another gain of over $2,000,000. After deductions from income for extraordinary expenditures and on account of principal of equipment trusts $580,000 larger than in 1905, and the one per cent. annual dividend requirement of $627,907, there was a profit and loss balance remaining for the year of $1,426,577 against $291,258 in the preceding year.

Most of the increase in gross earnings came from freight traffic. Earnings from freight were $3,356,336 larger than in 1905, a gain of 20.9 per cent. Passenger earnings were $348,411, or 8.9 per cent. larger than in the preceding year. These gains were made on an average operated mileage of 1,794 miles, 121 miles more than in



Chesapeake & Ohio.

1905. Considering the gain in freight traffic from a tonnage standpoint, coal and coke showed an increase of 1,775,028 tons, or 21.9 per cent. and other freight of 128,706 tons, or 24.8 per cent. The total tonnage carried and total number of ton miles each increased 23 per cent., while there was an increase of only 16.8 per cent. in the freight train mileage including mileage made by light trains. The number of tons one mile per mile of road was 2,575,392, against 2,244,776 in 1905, an increase of 14.7 per cent. Freight earnings increased $1,223 per mile of road.

In the 1905 year, operating expenses showed increases in maintenance of equipment and conducting transportation, and decreases in maintenance of way and general expenses. This year, with the great increase in business, there were increases in every department of current expense. Instead of a decrease of $118,800 in maintenance of way, as in 1905, there was an increase of $460,700. Maintenance of equipment increased $391,600 against $419,000 in 1905. Conducting transportation, which showed an increase in 1905 of $257,000, increased $947,000, and general expenses against a decrease of $88,600 in 1905 increased $49,400. As a whole operating expenses were $1,848,489 larger than in 1905 when the total increase over 1904 was $467,776.

On maintenance of way and structures there was an expense of $1,477 per mile of road against $1,308 in 1905. Maintenance of equipment, including replacements, cost $2,114 per locomotive, against $2,230 in 1905, $1,091 per passenger car against $893 in 1905 and $92 per freight car against $94 in 1905.

During the year there was an increase of mileage in operation of 119 miles, 85 miles of which came from the extension of the Big Sandy Railroad from Whitehouse, Ky., to Elkhorn City, at the breaks of the Big Sandy river. This branch opens up important new coal territory. New branch line construction authorized includes the Potts Creek branch 20 miles long connecting with the main line at Covington, Va., and several extensions of the Coal River Railway aggregating about 50 miles, the former to develop iron ore and the latter, coal properties. The most important construction work which has been under way has been double tracking. Work has been carried on from year to year and is being especially actively prosecuted at present. Some 90 miles of new second track have now been authorized, whose completion will make a total of about 360 miles in operation. The Chesapeake & Ohio will then have, counting the two main lines between Richmond, Va., and Clifton Forge as double track, with the exception of 131 miles, 103 of which are in Kentucky, a double track line from tidewater at Newport News to Cincinnati, 655 miles. Most of the double tracking has been done at points where it will expedite the company's heavy eastbound bituminous coal traffic.

It is by improvements such as this that the road is able to make a good profit from the low rate which it receives. The average ton mile earnings from all freight were last year 0.42 cents and on coal 0.327 cents. To make these rates profitable it is of course necessary to haul coal in heavy train loads. Here the Chesapeake & Ohio has an exceptional record. Ten years ago in 1896 the average revenue train load was 325 tons, at that time considered a remarkable figure. Last year the company carried an average revenue load of 586 tons and, including company freight, the train load averaged 616 tons, the former an increase of 29 tons and the latter of 31 tons over the preceding year. These loadings would not be possible if it were not that over half the tonnage carried is coal. Bituminous coal in 1906 made up 57.46 per cent. of the total, and with coke 60.33 per cent., the next largest items of traffic in their order being lumber 10.73 per cent., miscellaneous 4.37 per cent., grain 3.53 per cent. and merchandise 3.32 per cent.

On the whole road there are 568 miles of main track laid with 100-pound rails, 209 miles with 85-pound rails, 818 miles with 75 and 70-pound rails and only 270 miles out of the total 1,865 miles laid with rails of lighter section. Last year there were 19,571 tons of new rails used in renewals and 5,571 in new second track, a total of 25,142 tons of new rails covering 172 miles of track.

Through new equipment trusts 53 consolidation locomotives and 2,999 steel gondola cars were added to the equipment. There were bought outright and charged to income as extraordinary expenditures, 10 first-class coaches, 2 parlor, 1 dining and 2 express cars. Five hundred gondola cars were purchased and charged to operating expenses and 500 box cars of 80,000 lbs. capacity bought from the proceeds of a special fund received from the sale of the controlling securities of the Chesapeake & Ohio Steamship Company to the minority stockholders in England. In all there was an increase of 53 locomotives, 15 passenger cars and 3,255 freight and miscellaneous cars in the equipment owned and leased.

Although burdened with a somewhat larger capitalization and not making as extensive appropriations for betterments as its near and similar neighbor, the Norfolk & Western, the Chesapeake & Ohio, along with the great prosperity in the bituminous coal trade is rapidly coming into a stronger and stronger financial position, so much so that it is probable that the demand which is under way for a larger dividend than the 1 per cent. now annually distributed, must shortly be recognized. The road earned last year, after charges, 7.33 per cent. on its capital stock, and after payment of more than $2,500,000 for betterments out of this net income, 3.27 per cent.

The principal results of the year's operation are given below:

	1906.	1905.
Mileage worked	1,793	1,672
Passenger earnings	$4,242,556	$3,894,145
Freight earnings	19,395,648	16,039,313
Gross earnings	24,602,989	20,724,371
Maint. way and structures	2,649,557	2,188,835
Maint. of equipment	4,469,590	4,077,943
Conducting transportation:		
Traffic	434,755	409,768
Operation	6,959,355	6,037,680
Operating expenses	14,869,649	13,021,160
Net earnings	9,733,339	7,703,211
Net income	4,607,223	2,871,639

Norfolk & Western.

The past year has in several ways been of more than ordinary importance in the history of the Norfolk & Western. In December, 1905, the dividend rate on the common stock was raised from 3 to 4 per cent., a step recognizing in some degree the recent prosperity of the road. More important than this was the formulation in January, 1906, of a general program of improvements and financing to cover the new requirements. A third event which came early this month (after the close of the fiscal year) was the announcement that the Pennsylvania had sold $16,000,000 of its $33,830,000 holdings of Norfolk & Western stock, thus reducing its ownership from about 40 to about 20 per cent. of the total. A fourth fact that makes the year notable is that earnings are by far the largest on record.

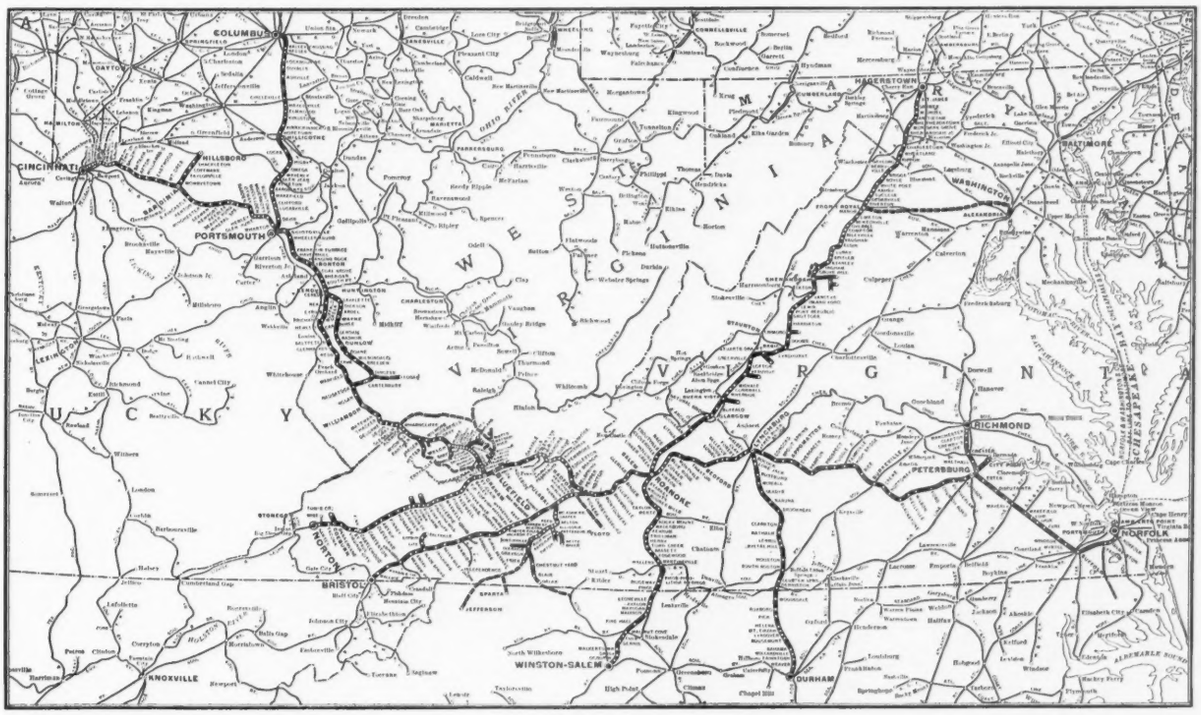
The improvement policy as outlined by the President marks an era in the history of the road in that for the first time since the reorganization in 1896 it has felt itself strong enough to begin a definite improvement policy covering a term of years. Admitting that the industrial demands of its territory have not been fully met, the company now adopts a broader and more permanent policy for future betterments. Among the more important improvements already under way are two low grade lines known as the Forest branch and the Concord branch, west and east of Lynchburg, Va., with a length together of 14.5 miles and a revised line with second track from Forest to Montvale 26.6 miles. This work, in addition to furnishing new local transportation facilities, will give when finished a new low grade line which can be operated in connection with the existing line as a double track and will do away with present heavy grades against eastbound traffic. The other important improvements already being made include a storage and assembly yard at South Norfolk, extensive enlargements of the Roanoke, Bloomfield and Williamson yards and large additions in both locomotive and car departments to the Roanoke and Portsmouth shops. Among more important improvements yet to be undertaken are new lines to reach the iron ore deposits of the Potts Creek valley, the continuation of the double track system by the building of some 70 miles of new track, much of which necessitates revision of the line and many new tunnels, and new passing tracks at various points on the system. With the completion of the double track work indicated, the company will have a continuous double track with grades and curvatures favorable to economical operation from Concord, Va., to Kenova, W. Va., 377 miles. There has not been mentioned the need for additional equipment which for the past few years has regularly grown faster than it was possible to fill it. To cover the new requirements the stockholders have been asked to authorize an increase of $34,000,000 in the common stock, raising the total to $100,000,000. The new stock is to be held against a new issue of $34,000,000 convertible bonds, also to be authorized, to be issued from time to time to provide for the improvements.

The income account for the past year shows clearly enough why there is a necessity for putting the company's affairs on a broader basis. After the decidedly favorable results of 1905, the year ended June 30, 1906, shows a surprisingly large increase in earnings. Gross earnings were $28,487,766, an increase of $4,398,506, or 18 per cent. over 1905. Net earnings show an even larger proportionate gain (20 per cent.), being $11,423,142, against $9,474,826 in 1905. After dividend payments larger by $644,692, and appropriations for betterments and equipment larger by $700,000 than in the previous year, there was a profit and loss credit for 1906 of $760,000, against $450,000 in 1905.

The all important majority of the company's traffic is comprised in the two commodities, bituminous coal and coke, which together furnish 61.5 per cent. of the total tonnage. It was in these and the other classes of heavy traffic that the year's large increases came, bituminous coal showing an increase of 1,325,246 tons or 16.2 per cent.; coke, of 411,511 tons or 21.1 per cent.; iron ore, of 262,648 tons or 43.9 per cent.; limestone, of 173,654 tons or 98.9 per cent., and pig iron, an increase of 134,704 tons or 30 per cent.

These latter increases go to show the rapidly increasing importance of the iron industry along the lines of the road.

The large proportion of heavy traffic is reflected both in the average train load and in the ton mile rate, two factors which are in reality dependent on each other, for without economy in carrying, the average rate of 0.481 cents per ton mile could not be made profitable. In 1897 the Norfolk & Western hauled an average train load of 325 tons, in 1905 the figure was 531 tons and last year showed the striking addition of 48 tons to the total, bringing the average figure to 579 tons, with the average freight loading per loaded car mile 25.57 tons, an increase of 1.42 tons over the preceding year. These figures of course show clearly enough the efficiency with which the road is operated.



Norfolk & Western.

In view of the recent agitation in regard to car distribution to bituminous coal mines, it is interesting to observe the amount of new equipment received by the Norfolk & Western during the past year. This was obtained through three channels. First, from a fund for acquiring additional equipment, appropriated out of surplus earnings. Second, through an equipment renewal fund used for replacement of destroyed equipment. Third, and most important, through equipment trust agreements. Without considering in detail from which of these three sources the year's new equipment was received, the total acquisitions amounted to 5 passenger locomotives, 26 passenger train cars, 29 miscellaneous cars, 65 freight locomotives, 1,000 box cars of 80,000 pounds capacity, 1,500 drop bottom gondolas of 100,000 pounds capacity and 3,120 hopper coal cars of 100,000 pounds capacity. These represent increases in the equipment roster of 26 passenger cars, 66 freight locomotives and 4,780 freight cars. That cars and engines are well maintained may be judged from the fact that the charge for repairs only (replacements not included) was $2,203 per locomotive in 1906 against $2,129 in 1905; $627 per passenger car against $667 in 1905, and $51 per freight car against $49 in 1905. A further evidence of the good condition of the equipment is the fact that at the close of the year there were in the shops undergoing or awaiting repairs 57 locomotives or 7.8 per cent. of the total (of which 14 needed only light repairs), 22 passenger cars or 6.3 per cent. of the total and 696 freight cars or 2.2 per cent. of the company's freight cars.

Maintenance of way and structures in 1906 cost $1,856 per mile of road as compared with $1,721 in 1905. In addition to this regular expenditure there was a charge against the betterment fund for similar expenditures during the year of $2,346,442 out of a total expenditure for construction betterments of $5,649,198. At the same time there was appropriated to the betterment fund from surplus earnings $2,250,000 against $1,000,000 in 1905. It is evident that the physical improvement and betterment of the road is being steadily and extensively carried on.

In the official circular announcing the sale of nearly half its Norfolk & Western holdings, the Pennsylvania Railroad gave as its reason for the purchase of this stock some six years ago, a purpose to secure co-operation in doing away with secret rebates. The increase in the ton mile rate received by the Norfolk & Western from 0.397 cents in 1899 to 0.481 cents last year shows that this object was accomplished and the rapidly increasing earnings of the road have shown with how great advantage to the Norfolk & Western. Provided that as indicated further in the Pennsylvania's public statement there is no likelihood that the railroads of the country will fall back into the old and costly practice of rate demoralization, there appears to be a splendid future for the Norfolk & Western, for its territory is enormously rich in bituminous coal of the highest quality and its line is becoming more and more efficient for handling its traffic.

The principal results of the year's operation are given below:

	1906.	1905.
Mileage worked	1,853	1,799
Passenger earnings	$3,598,558	$3,158,773
Freight earnings	24,111,801	20,249,399
Gross earnings	28,487,766	24,089,260
Maint. way and structures	3,439,797	3,095,910
Maint. of equipment	4,749,832	3,917,268
Conducting transportation:		
Traffic	441,678	415,285
Operation	7,913,695	6,721,199
Operating expenses	17,064,624	14,614,434
Net earnings	11,423,142	9,474,826
Net income	7,452,375	5,833,454

Grade Crossings in Yonkers.

The New York State Board of Railroad Commissioners has ordered the elimination of the following grade crossings of the New York Central & Hudson River in the city of Yonkers: Pier street, Fernbrook street, Dock street, Wells avenue, Ashburton avenue, Main street, Vark street and Babcock place. The board further determined that the one-fourth share which the state should pay shall not exceed $138,000. The New York Central has stipulated that the city of Yonkers shall not pay more than this sum. The total grade crossing appropriation made by the Legislature this year was $250,000. In addition to the Yonkers cases, a large number of other eliminations have been ordered.

A question having been raised concerning the powers of the Commission in the New York Central's electric zone, the board has decided, after securing the opinion of the Attorney General, that it has full power to order changes there, regardless of motive power used, but that neither the state nor the city shall bear any larger proportion of the cost than if the number of tracks were not increased. When, in order to do away with a crossing, the location of railroad tracks is changed, the state and city cannot be charged with more than if the crossing were left at its original location.

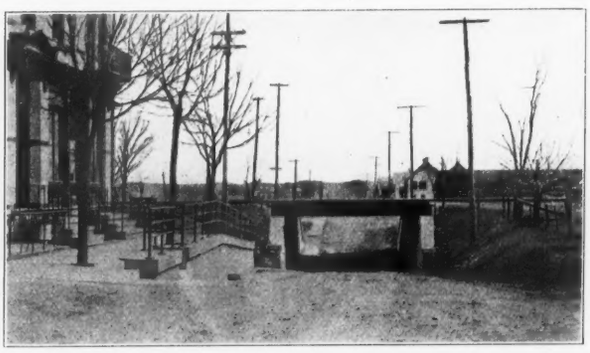
Grade Crossing Elimination—An Object Lesson.

What grade crossing elimination means in congested parts of the country, and how urgent the need for it is, can in no way be better shown than by a series of pictures like the accompanying ones. New York is too rich a state and too populous to allow a continuance of conditions such as those shown in the "before removal" series. The railroads are most ready and eager to assume their lion's share of the burden; it remains for the communities to share the spirit of willingness to assist in the work, and for the state to appropriate something more than the miserably inadequate pittances of the past. Both state and municipality ought to be able to take the matter of grade crossing elimination clean out of the realm of politics, and view it as being a duty as simple and as urgent as police protection of the lives and property of citizens.

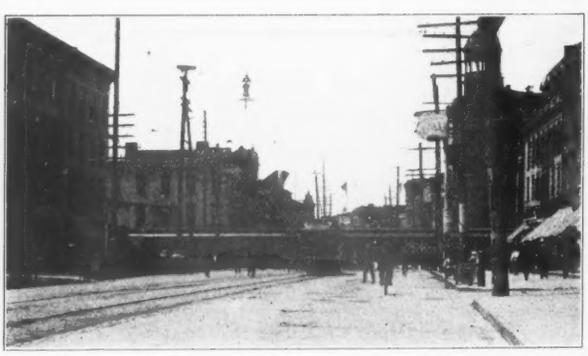
Sample of Eleven Crossings on Port Morris Branch.

Port Morris Branch; Grade Crossings Eliminated.

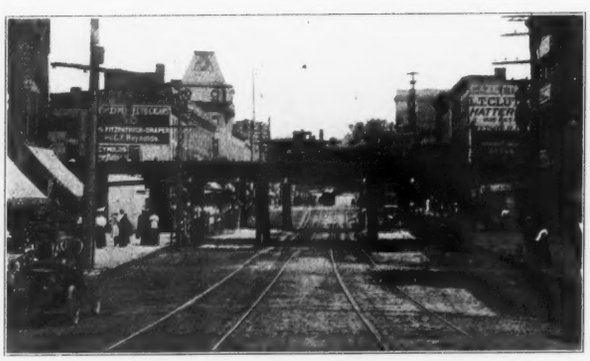
Westerloo Turnpike, Ravena, N. Y., as It Was.



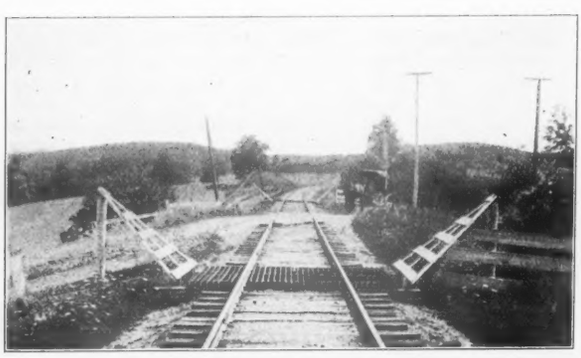
Westerloo Turnpike After Elimination.



The Disgrace of Schenectady—Before Elimination.

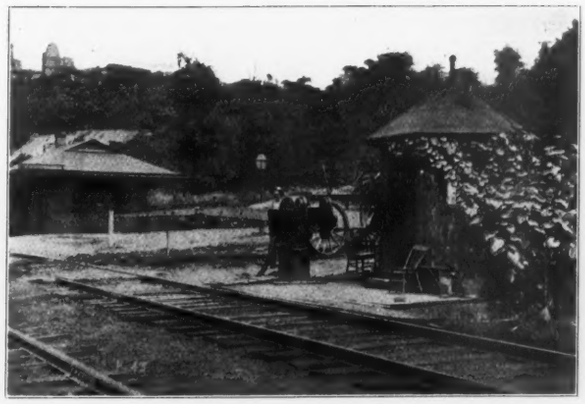


Work in Progress on State Street Crossing, Schenectady.



Bloomfield Road, Ionia, New York.

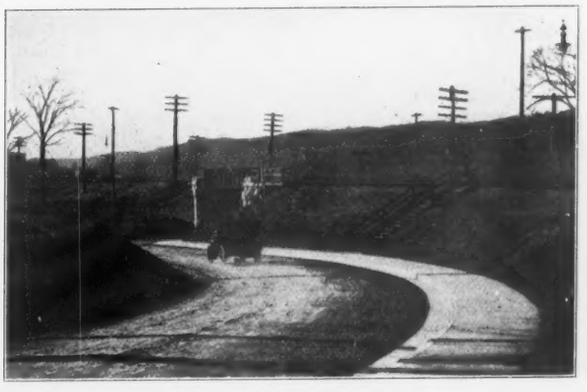
Bloomfield Road—Present Ionia Crossing.



University Heights, N. Y. City—Before Elimination.

University Heights; Same Crossing After Elimination.

Gun Hill Road, Van Cortlandt Park, N. Y.—Before.



Gun Hill Road, Van Cortlandt Park, N. Y.—After.

Woodlawn, 233d Street Crossing, Before Change.

233d Street Crossing To-day.

Typical Eastern New York Crossing—Before Elimination.

Same Crossing, After Separation of Grades.

Repairs to Wide and Narrow Fireboxes.

In an address before the recent convention of the Master Boiler Makers, Mr. James F. De Voy, the mechanical engineer of the Chicago, Milwaukee & St. Paul, gave some interesting data regarding the repairs required by wide and narrow fireboxes. From this it appears that in repairs the narrow box is the more economical of the two, especially in high-speed locomotives. Of 18 Atlantic type passenger locomotives built in 1896 to 1901, with the narrow firebox, four have had new door, flue, crown or side sheets; while of 28 Atlantic type with wide fireboxes, built in 1901 to 1903, each has had new door, flue, crown or side sheets, and some of these locomotives have had the sheets renewed as many as three times. For a period of one year we applied 140 staybolts to the narrow firebox engines, while for the same period 585 were applied to the wide fireboxes.

In one year seven arch tubes were applied to the narrow boxes, and for the same time 79 were applied to the wide boxes. In nearly every case where a new flue sheet, side sheet or arch flue was applied, the brick arch had to be destroyed.

In the case of freight engines with a slower speed than the Atlantics, the wide firebox shows up to better advantage. Sixteen 10-wheel freight locomotives built in 1900, with narrow fireboxes, are still running with their original boxes. Of 66 locomotives of this type, but with wide fireboxes and built from 1901 to 1903, 14 have had new door, flue, crown and side sheets. During a period of 1½ years, 152 staybolts have been applied to narrow boxes, 1,127 have been applied to the wide boxes.

For a period of one year, 14 arch tubes were required for the narrow boxes, while the wide required 72. In looking up the reports of leaky flues and staybolts, we find it is about one in the narrow to 10 in the wide box. A set of flues lasts nearly twice as long in the narrow firebox as in the wide.

In comparing the fuel consumption of the above freight engines doing the same work, and over the same division, it was found that for a period of three months the narrow firebox engine used 17.45 lbs. of coal per 100 ton-miles, while the wide box engines used 17.56 lbs., a saving of .11 lbs. per 100 ton-miles in favor of the narrow firebox. As regards comparative coal consumption, I believe a great deal depends on the fireman, who has to be more precise in the performance of his work with a wide firebox, because he carries a lighter fire, and any inattention on his part is liable to allow a hole to be burned in it, which will seriously effect the steaming. With the larger grate area there is more air admitted to the furnace than is necessary for proper combustion, and this, with a hole in the fire, would have a tendency to lower the temperature of the firebox gases and reduce the rate of evaporation, besides its effect on the flues and side sheets. We have found that firemen are more extravagant in coal consumption when firing wide fireboxes, and believe that a good many cases of leaky flues and cracked side sheets can be laid to the irregular firing in wide boxes.

I believe that the wide firebox is an essential factor in the large modern boiler of to-day, and has an important bearing on the ability of the boiler being capable of furnishing steam as fast as the engine demands it. In a boiler of about 3,400 sq. ft. total heating surface, with a wide firebox and a grate area of 51 sq. ft. the ratio of heating surface to grate area is 66.6 sq. ft. If the same boiler had a narrow firebox, the greatest dimensions we probably could make, it would be 41 in. wide by about 120 in. long, as the ordinary fireman could not throw the coal much more than 10 ft. This would give a grate area of 35.84 sq. ft., leaving a ratio of total heating surface to grate area of 94.8. This ratio taken from about a dozen of the latest designs of locomotive boilers shows an average of 65. So that were this boiler equipped with the narrow box, it would be a departure from all present designs, and would not supply sufficient heat to generate steam as fast as would be demanded by an engine that would require this size boiler. A moderately wide firebox, with flat firebox side sheets and wide water legs to admit of free circulation is what we are coming to. In the narrow box, where the fire is forced to its utmost, the flow of steam upwards in the water legs must be so great that there is not much water flowing down, so that most of the water coming into the legs gets in at the front, through the space between the flue sheet and outer shell, and if the water leg is made wide, this will greatly help the circulation and decrease the number of burned side sheets.

In certain designs of locomotives where the wide firebox is used a flue of 14 ft. or longer is necessary, unless the front flue sheet is set considerably back in the boiler, or a combustion chamber is used. Our records show that more leaks have developed from long flues than from short ones, and as the decrease in the efficiency of tube heating surface, taken from the back to the front flue sheet, is very rapid, probably a ratio of 10, there is nothing gained by the long flue, so that it would be better to put in a combustion chamber, or extend the back flue sheet forward until the proper length of flue is reached, as this would give a greater firebox heating surface, and is just where it will do the most good, since the firebox heating surface is exposed to the highest temperature and evaporates about 50 per cent. of the total. This combustion chamber would also keep the flues further away from the fire door and grates, and any cold air coming in through these openings would be heated to nearly the firebox temperature before reaching the flues. The influx of cold air against overheated flues and cracked side sheets, and the wide range of temperature to which flues are subjected loosens the circumference and draws them in and out longitudinally. A generous depth of throat should be given whenever practicable. In a shallow throat where the brick arch is supported on arch tubes, very little space is left between fire and brick arch, and in a sloping firebox the coal and clinkers have a tendency to work down in the corner and choke up. The deep throat also gives greater firebox heating surface.

The possibilities are that we will have a firebox which will be dropped still a foot further. It will go 36 to 38 in. below the throat sheet. In order to prove that that can be done, I want to say that the average wide firebox locomotive in the United States has a 36-in. wheel on the engine truck—for a trailer. There is no good reason why a wheel should be set up there and take away the space which you should have for heating surface. There should be sufficient room for the gases to mingle.

To-day a 21-ft. flue is being put in many boilers, and we are coming to a 24 or 35 ft. flue. It isn't the length of the flue that is causing the trouble, for a long one can be handled just as easily as a short one. If, however, there is an objection to this, the thing to do is to go back to the old combustion chamber and so shorten the flue by three feet.

Demurrage and Private Sidings.

The Supreme Court of the United States has decided that a railroad need not send cars of bulk freight out of its possession—that is to say, set them on a private siding—when demurrage charges are due, as the lien on the freight for these charges is the railroad's only security. This decision was in a case which came up in North Carolina, and the North Carolina Car Service Association has issued a pamphlet giving an account of it.

The Greensboro Ice and Coal Company had a private siding for the delivery of coal, and a dispute arose concerning demurrage charges on thirteen cars of coal and wood. The coal company refused to pay these charges, and the railroad (the Southern Railway) refused thereafter to deliver cars except on the public team track. Thereafter the coal company ordered four cars of coal from points in Pennsylvania, West Virginia and Tennessee. The coal company declined to receive the cars, except on its private siding. After about ten days the road placed these cars on a distant siding, to prevent unnecessary interfering with other business. The laws of North Carolina of 1899, chapter 164, and acts amendatory, prescribed penalties upon railway companies for violation of the rules of the Commission. The Corporation Commission, after informal correspondence, made an order for the delivery of the four cars of coal upon the private siding, to which the railway company excepted, and hearing was had before the Commission on December 10, 1903. At this hearing the railroad averred that there was $146 demurrage due on the cars; that this sum accrued under the Commission's rule No. 36 and that to force delivery would force the road to give credit and lose its lien. But the Commission sustained its former order. On January 5, 1904, a bill was filed in the United States Circuit Court to perpetually enjoin bringing of actions by the coal company and by the Commission to recover penalties or damages under the authority of the aforesaid statutory provisions, because of the non-compliance of the railway company with the order of the Commission. The railway company averred that it had a common defence, based upon the Commerce Clause of the Constitution of the United States, the provisions of the Act of Congress to regulate commerce, and the due process clause of the Constitution, and also because the Corporation Commission was an illegal body, as it was empowered to exercise judicial, executive and legislative functions, contrary to the Constitution of the State of North Carolina and of the United States. The Circuit Court decreed that the order of the Commission was repugnant to the Commerce Clause of the Constitution, and the defendants were perpetually enjoined.

The United States Supreme Court in its opinion held, first, that though the amount of demurrage charges may have been the origin of the litigation, yet the right of the railroad company to carry on interstate commerce in North Carolina without becoming subject to the orders or directions of the Commission and the right to carry on its interstate commerce, freed from penalties imposed by the said statute exceeded the sum of $2,000, exclusive of interest and cost and a much greater sum, and therefore removal to the Federal Court was proper. Second, that the suit was not one against the state, but against those assuming to act for the state, in violation of the rights of the railroad company, protected by the Constitution of the United States. Third, the four cars in question were the subject of interstate commerce.

The order of the Commission directly burdened interstate commerce, and is a regulation of interstate commerce that is repugnant to the Constitution of the United States.

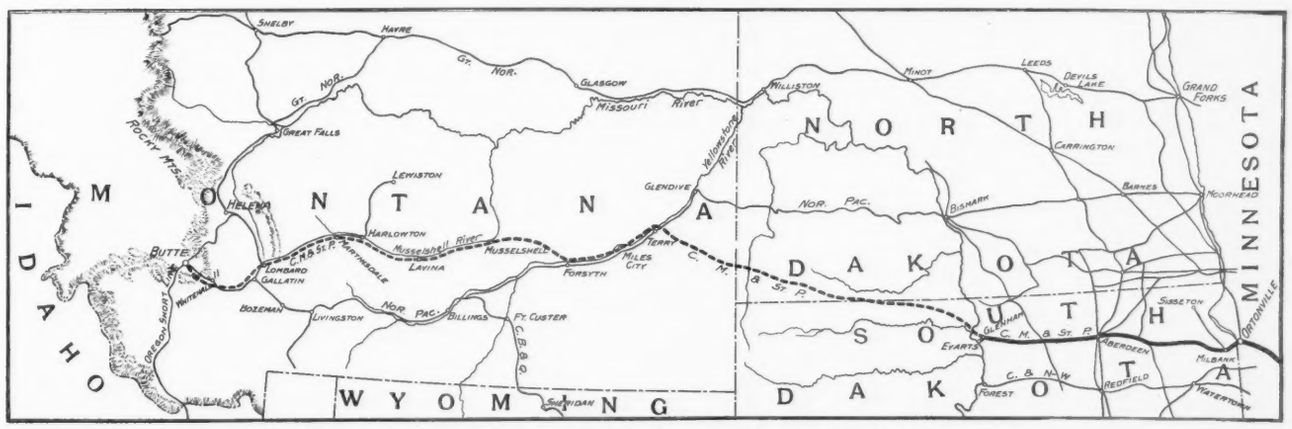
The St. Paul's Pacific Extension.

The Chicago, Milwaukee & St. Paul has issued a map which shows in a general way the location of the portion of its new line to the Pacific Coast between Glenham, S. D., and Butte, Mont. Glenham is the last station but one on the Aberdeen-Evarts line, being eight miles north of Evarts. Crossing the Missouri River about 12 miles northwest of Evarts, the line runs northwesterly through the Standing Rock Indian Reservation, which is about 80 miles wide. It parallels the state line between North and South Dakota for a short distance, finally crossing into the former. The Little Missouri River is crossed about 10 miles east of the Montana boundary, the line continuing northwesterly to a crossing of the Northern Pacific Railroad and the Yellowstone River a few miles east of Terry, Mont. The objective of this portion of the line is Miles City and a more southerly route, approximating more nearly to an air line between Glenham and Miles City, was considered; but the country to be traversed is quite rough, with high divides between north and south creeks, while the route chosen follows the direction of drainage into the Yellowstone.

The portion of the line east of the Yellowstone River lies from 40 to 60 miles south of the Northern Pacific. From its junction with the latter near Terry, to Forsyth, 85 miles, it parallels the Northern Pacific, following the Yellowstone, there being no other route possible, although it was preferred to avoid doing this had topographical conditions permitted. The line lies on the north bank of the river, except where it crosses to get into Miles City, which is to be a division point.

From Forsyth the line strikes northwest toward the Musselshell River, the valley of which is followed to a junction with the Montana Railroad at Harlowton. The C. M. & St. P. has a proprietary interest in this line and the portion from Harlowton to Lombard, already in operation—95 miles—will form a link in the new transcontinental line. Suitable revision of its grades is to be made and heavier rails laid. At Lombard the Missouri river is again crossed and the Northern Pacific is paralleled into Butte, the two lines crossing once more near Whitehall. Entrance to Butte will be through Pipestone Pass, at an elevation of about 6,350 feet. Three tunnels will be required, the longest of which will be about 2,400 feet.

The total length of the line to Butte is 731 miles. Work was begun in April and at the present time is being prosecuted quite generally along the entire route. Most of the work will be of heavy and difficult character, but it is hoped to have it completed by the early part of 1908. The largest river crossing will be the Missouri, at the eastern end of the line. The three Yellowstone crossings will be from 1,000 to 1,200 feet long, and the Little Missouri at Lombard 500 to 600 feet. No official announcement has yet been made regarding the remainder of the route to the Coast, but it is expected that this will be done shortly.



Map Showing the Eastern Part of the St. Paul's Pacific Extension.

Tonnage Rating for Locomotives.*

As a basis for calculating the maximum rating we start out with a resistance of 5 lbs. per ton rolling or frictional resistance, 20 lbs. per ton of each per cent. of grade, and ½ lb. resistance for each degree of curvature, where the curves are compensated for 45 miles per hour speed. For the minimum rating we allow the same for grades and for curvature as with the maximum, but for the rolling resistance we allow 8.5 to 10 lbs. per ton, so with an engine of 40,000 lbs. tractive power, weighing 160 tons, we find on a one per cent. grade that it could pull 1,270 tons.

Another factor entering into the resistance column, very often the controlling one, is the wind resistance. This factor, I regret to state, has not been satisfactorily adjusted anywhere, although we all know that a quarter wind offers the greatest resistance. Still on account of the variety of cars composing the average freight train it is impossible to fix any set percentage of reduction. The writer had an experience which is a practical example of wind resistance. It was on a freight train in Western Kansas on a light grade. The wind was blowing about 25 miles an hour, but the train being protected from the full force of the wind by the bluff and foot hills, made fairly good speed. Upon running out into the open country and crossing a trestle where the wind had a fair sweep at the train the resistance was sufficient to momentarily stall the train. For a few seconds there would be a lull in the wind and the engine would make some headway until a stronger gust of wind would strike the train and the engine would stall again. This was repeated for at least five times in the distance of 200 yds. I fear this question of what practical reduction to make for the various winds will for years to come be left in the hands of the train despatcher.

Another factor which enters the resistance column is the temperature. In the extreme southern section of the country where the temperature is even throughout the entire year or never below the freezing point, it is not necessary to take into consideration the temperature, but in the colder climates where the prevailing temperature in winter is below the freezing point we find it is necessary to make considerable reduction. It is a custom of the western roads and some of the divisions on the Santa Fe System, to make a reduction of 10 per cent. between the months of November and April under favorable winter conditions. But it has been our experience for a frosty or wet rail to make a 7 per cent. reduction. from 32 deg. down to zero Fahrenheit make a 10 per cent. reduction, and from zero below to make a 20 per cent. reduction.

In addition to this we have another reduction which the writer thinks should be made, but at the same time it is a very delicate question, namely, the reductions on account of the condition of the engine. We feel sure that were any road to simply make a reduction on the condition of the engine, there would be a continual warfare between the mechanical and transportation departments, unless the condition be based on the mileage the engine makes and allowance for the time the engine has been out of the shop; nor are we aware of any road that allows any reduction to be made on account of the condition of the engine. We do believe, however, that the reductions should be made for the condition of the engine, that is the master mechanic and traveling engineer should say what is the condition of the engine, and each engine should be placed under a certain class or number of condition rather than the time that it has been out of the shop. The engines should be divided into three classes. If an engine is in good condition and good for maximum tonnage, call it A class; when she reaches a certain condition a reduction of 10 per cent. should be made. Call this class B, and then the third class with a 20 per cent. reduction, call C. After this the engine should go to shop, for it does not pay any road to keep an engine in service if it is necessary to reduce the tonnage below 20 per cent. of the regular rating.

Of course we realize the fact that it would be quite a task for the Master Mechanic to say why the engine is not in No. 1 condition. Until the roads adopt or the officials stamp their approval upon a scheme of this nature, tonnage rating will continue to have a disagreeable drawback.

Recent tests which the writer has made with cars equipped with ball or roller center and side bearings, proved that with the modern roller or ball bearing an increase of about 7 per cent. tonnage can be hauled over divisions having a number of curves; in other words, on a 6 deg. curve the engine could start fully 100 tons more in cars having roller bearings than in cars having ordinary slide bearings.

While in motion, a train moving eight or nine miles an hour

*Extracts from a paper presented to the Convention of the Traveling Engineers' Association, by F. W. Thomas, Eng. of Tests, A., T. & S. F. Ry.

on a tangent with the common slide bearing the speed of the train would reduce from one and one-half to two miles an hour when pulling around curves; with roller bearings the speed would be reduced only three-fourths to one mile an hour. This slight increase of speed would allow the train with the roller bearings to attain a higher speed on a straight track, pick up speed on short tangents, and approach the next curve with a greater momentum.

We all are aware that there are very few trains of the same number of cars and the same weight which will pull alike. The writer, when making some tonnage tests on mountain divisions, got along nicely with the maximum theoretical tonnage with one set of cars; but on the second trip with the same weather conditions, same engine, same number and class of cars, and with 50 tons less load actually stalled and was unable to pull the tonnage over the same territory.

We have always been able to pull nearer the maximum tonnage with compound engines than with the simple engines. It is our custom to give simple engines a lighter rating than compound engines. With the simple engines, when they stall it is a matter of doubling the hill; with the compound engines we always have the simpling lever to fall back on to tide us over the critical point.

There is one point in reference to tonnage rating that I wish to dwell on for a moment; it does not particularly injure an engine to pull her tonnage, although it is a little harder on the cylinder and frame to work at full capacity. At a speed of six to seven miles an hour it is not as hard as it is when running at a higher speed, for more power is developed at a higher speed (evaporation is greater, fuel consumption per hour is greater) than will be developed at seven miles an hour. The engine will burn more coal per hour when running at 15 miles per hour than when running at seven miles an hour. It is true the total consumption over a division is greater on account of her being on the road longer; but what does the injury is to have the engine out for such long hours—the engine crew becomes worn out, the water in the boiler becomes foul, the fire-box becomes dirty, causing an irregular steam pressure, resulting in leaky flues, etc. This one thing is more harmful to an engine than the fact that she is pulling heavy tonnage.

We advocate that where the division is 100 to 110 miles in length the full rating should be given the engine; but where the division is longer the rating should be decreased in consideration of the length of the division. Not a decrease proportionally, but decreased sufficiently in order that the total time over the division should be reasonably close to the time over the division 100 to 110 miles in length with full tonnage.

I regret that I cannot say which is the most economical rating to give an engine, as no test has been made of sufficient reliability to determine this question. It would require at least 18 months' time and considerable outlay of expense to determine the question, it being necessary to know the actual cost of hauling the freight and the same class of freight should be used in the test, as well as the same territory and the same class of engines. Comparison between two or more roads would not be of any value, because there are few roads that have divisions of the same lengths and grade and engines of the same class. A test could easily be made to determine what rating would be most economical as to fuel, for this could be made within a few days, but to determine the amount of repairs to the engine as well as ascertain the revenue derived from the train hauled, will, as stated above, have to extend over a period of at least 18 months.

The full engine rating can be hauled cheaper on a double track than it can be hauled on a single track; for where there is a road with sufficient business to move the engines on a tonnage rating basis there are always sufficient trains to cause considerable delays. However, a good deal of the expense of pulling in and out of sidings is eliminated by roads having two or more tracks.

We do think that on roads where traffic is sufficiently heavy to cause 25 to 50 per cent. delays in taking siding and getting orders, fully 10 per cent. reduction from the maximum rating should be made. Such reductions would enable the engine to make faster time between stations and consequently shorten the time that it would be on the road. We believe also that over divisions where the grades are undulating the engine should be loaded nearer the maximum rating than over those divisions where the controlling grades are 10, 15 and more miles in length.

On the undulating grades where the maximum pull is only three to four miles in length the momentum will enable the first mile to be covered in good time, and leave only two or three miles to be gone over with drag speed. Whereas, over the divisions where the grades are longer sufficient reductions should be made to enable the engine to go up these grades at a faster speed than the speed which she would otherwise make with the maximum rating.

In moving stock, vegetables, fruits and other perishable freight it is necessary to move this with despatch and with as little liability as possible from cattle shrinking in weight, or late in reaching market, fruit decaying, etc., else the loss will overbalance the extra revenue gained by hauling heavy tonnage. These are classes of freight generally moved at a set schedule and are hardly classed as tonnage trains.

The Use of Concrete Piles.*

Though the use of wooden piles for foundation work is very extensive the constantly increasing cost, as well as the necessity that they be kept submerged, coupled with the danger from the teredo in some climates and countries, has rendered it desirable that a substitute should be found. Metallic piles may be made to answer but they are unreliable in the matter of durability.

On the other hand, reinforced concrete, with its power to resist the action of water and mechanical stresses, seems to be especially well suited for this work. It is quite true that the making and driving of such piles must be accomplished with great care, but the rules are now so well known that, with these observed, the piles can be depended upon.

The Hennebique pile resembles the ordinary concrete columns of the same maker, and is strengthened by round bars of a rather larger diameter with cross ties. The section is usually square or triangular and a metal shoe is provided at the point. The piles are driven in the same way that wooden piles are, and, like wooden piles, must be provided with a cap in order to transmit the blow of the drop. Their resistance to driving and their adherence to the soil is all that could be asked, but they are quite difficult to cut down when they are driven to refusal, because of the hardness of the cement and the presence of the metal reinforcement. Again, it is quite necessary that they should be made several weeks in advance of the time of using, in order that the cement may be given time to set; a requirement which, at times, may result in a delay in construction, and always in an increased cost. Once they have been made it is also almost impossible to

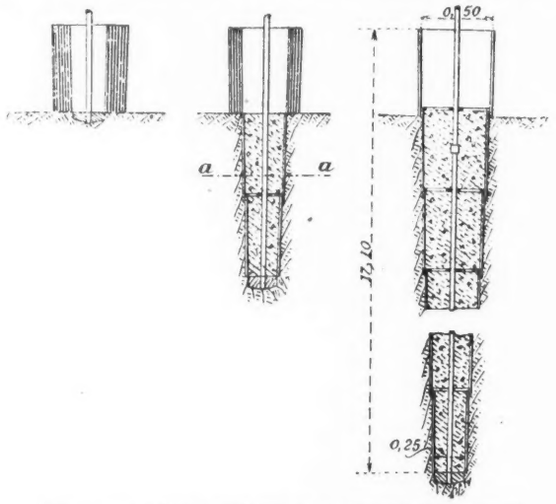


Fig. 1.—Vertical Section of a Foundation Formed on the Dulac-Compressol System.

lengthen them, for the transportation and the locating of the moulds is difficult and expensive while it requires a still longer time for the extension to harden.

The pile made by the Corrugated Concrete Pile Co. and that known as the Ferro-inclave are merely modifications of the Hennebique pile. Both are cylindrical or polygonal, with a large number of sides, and are slightly conical. The first is, however, characterized by the channels cut down each of its faces, whereby the friction of the pile against the earth is considerably increased; also by the fact that the main reinforcing bars are electrically welded to the circular ties, which are also peculiar in that they are formed of sheet steel bent in on itself and welded into a cylinder, of which the surface is bent into a number of corrugations. This method of reinforcement certainly ought to afford considerable resistance to lateral bending and insure a perfect union between the metal and the cement.

These two types of piles are usually made with a plate metal head, provided with a wooden striking piece, and are subject to the same objections cited in the case of the Hennebique pile. The first pile ever offered that was exempt from these disadvantages is the one used at the Exposition of 1900 for the foundation of the Creusot pavilion, and which was known first as the Dulac and then as the Dulac-Compressol.

Although the process is quite well known, it may be briefly reviewed. It consists in the use of a conical ram with a very sharp point that is driven directly down to refusal, thus making a cylindrical hole of its own diameter in any unstable ground in which the pile is to be formed. When the hole has been formed down to a solid layer, it is filled with concrete which is, in turn, compressed with another ram shaped like a rifle shell which tamps

*Translated from *Le Genie Civil* for the *Railroad Gazette*, by Geo. L. Fowler.

it and spreads it out laterally, thus enlarging the original hole by compressing the earth about it. In this way a sort of concrete pillar is formed, shaped like a truncated cone and standing on the solid ground, but with no reinforcement. The chief defect of this system lies in the large quantity of concrete that is used.

The next process, known as the Gow and Palmer pile, is a modification of the Dulac, and avoids this waste of the concrete. It is formed in soft earth by driving down an iron pipe, the inside of which is kept empty by a stream of water under pressure, until it has reached the required depth. The pipe is then slightly withdrawn and a lozenge-shaped cutter is sent down to the bottom of the hole. By turning this tool and, at the same time, opening it gradually, the earth that is cut away may be removed by the current of water. In this way a hollow cylinder ending in an enlarged base is obtained. This is then filled with concrete and tamped. As the hole is filled the pipe is gradually withdrawn, so that at the end a true concrete column is formed in place and rests upon its own enlarged base.

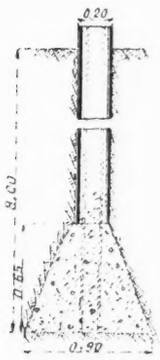


Fig. 2.—Gow & Palmer Pile.

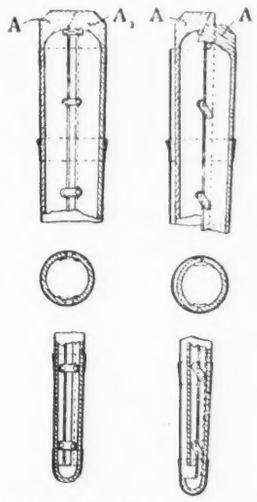


Fig. 3.—Mandrils for Forming the Raymond Concrete Pile.

If a reinforced column is desired it is merely necessary to put the necessary rods in the tube before the hole is filled in order to obtain a construction that can resist any lateral stresses.

The piles of the Raymond Concrete Piling Co., of Chicago, are built up in a manner similar to the preceding but without the enlarged base. On the contrary, they are given a slightly conical form with the point downward, so that the pile is enabled to carry the load that is put upon it by the frictional resistance that is thus set up between its purposely roughened surface and the surrounding earth.

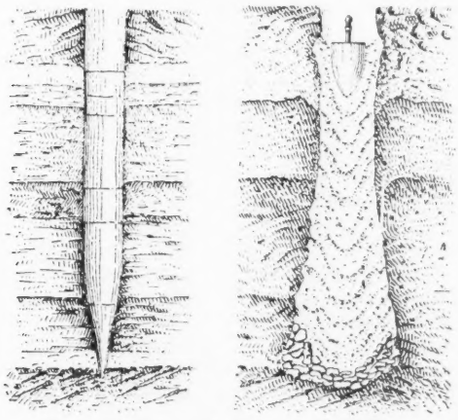


Fig. 4.—Raymond Pile for Soft Ground.

There are two forms of the Raymond pile. The first is ordinarily used in earth of a somewhat uniform consistency. In order to make these piles a mandril having the external dimensions and length of the pile to be set is driven into the ground by means of a drop. This mandril is divided longitudinally into two or three similar parts, immovable in the direction of driving, but fastened together by iron plates that can turn about their points of attachment, so that the several pieces can be displaced with reference to each other and thus change the diameter of the mandril. The latter is shown in the illustration. While being driven, the two halves are held with their heads AA (Fig. 3) flush with each other by a conical cap, so as to hold the mandril at its maximum diameter. When it has been driven to depth the cap is removed and a blow struck upon the head A with the drop, which drives it down with reference to A and thus lessens the diameter of the mandril so that it can be readily pulled out of the hole. The latter is, then, filled with concrete, tamped in place, and reinforced with steel.

To prevent the entrance of the earth into the mandril it is usually covered with a fender that protects the two halves in their working position. This consists of a thin sheet of steel fastened to one of them. This method of pile construction is especially advantageous where the pile is to be carried down through a water bearing stratum, for it is possible to cover the mandril with a metal shield, or even a simple paraffined cardboard, at the point where it passes through this stratum, which is driven down at the same time as the pile, and which can be left in the hole to shut off the water when the mandril is withdrawn.

In miry ground the Raymond pile is formed by filling a conical tube with concrete, this tube being formed of successive sections made of sheet steel and fastened like those of a telescope. The smallest socket at the center and bottom has a tube attached for carrying down water under pressure. This small shell is then gradually forced down to the required depth by cutting the ground away beneath it by means of the jet of water, the several conical sections being added successively, thus lining the hole, and they are filled with concrete as fast as they are put in position. The lining is naturally sacrificed by being left in place, nor can it be depended upon in the calculation of the strength of the pile, as it disappears very soon, but the central tube forms a true reinforcement.

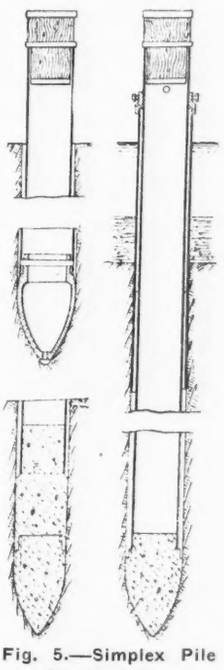


Fig. 5.—Simplex Pile with Steel Shoe.

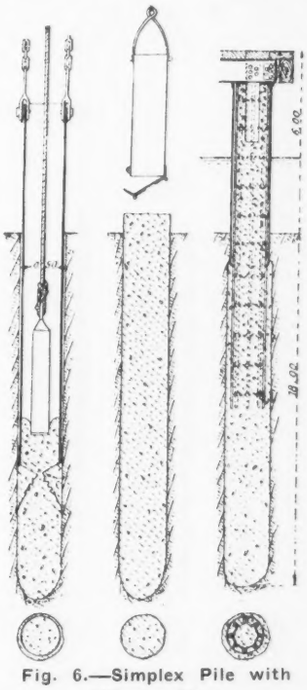


Fig. 6.—Simplex Pile with Alligator Shoe.

The Simplex piles are made as follows: A shoe in the form of a rifle shell made of a steel casting or even concrete is set down in the ground. At the upper end there is a collar to which a tube is attached. The shoe is driven down by a drop striking on a wooden block set on the upper end of the tube. The tube is then gradually filled with concrete tamped in place as it is sunk. When the pile has to pass through a certain depth of water a pilot tube is first driven into the ground from which the water is pumped. The shoe and the tube which lengthens it are then put inside it. A tight ring is sometimes used at the upper end of the first tube, thus forming a stuffing box. In this way a cylindrical pile is formed that is perfectly homogeneous, presenting a roughened surface and one offering great resistance to movement.

In recent construction the Simplex pile has been made much less expensive by doing away with the metal shoe that is always lost, and which is high-priced, and by using a special Alligator shoe. This is made of two half cones of strong sheet steel hinged to the end of the tube and each provided with a row of square teeth that mesh in with one another when they come together. In the driving position this cone is quite rigid and fulfills the functions of a shoe; but, when the concrete is dumped in and tamped, the two jaws of the Alligator open and permit it to pass so that the hole may be gradually filled as the tube is withdrawn. In this case the pile can be reinforced, but this is usually done only when

the upper portion is to form pillars projecting above the ground.

By the use of seven steam pile drivers 6,000 Simplex piles of about 20 in. in diameter and with a length of from 30 ft. to 50 ft. were driven for the foundations of the River Railroad Terminal Warehouse in 75 days, at the end of which time the erection of the steel framing for the building was begun, the caps connecting the heads of the pile and the anchor bolts having been put in as the piles were finished and became hard.

Raising of Canal Bridge at Schenectady, New York.

On account of the abolition of grade crossings through the city of Schenectady, it was necessary for the New York Central to raise several existing bridges at this place. Chief among these was Bridge 381 over the Erie Canal. This is a modified Pratt, through riveted truss bridge of 162-ft. span, and is built on a skew of 35 deg. It is a three truss, transverse trough, ballast floor bridge and carries four tracks, two on each side of center truss.

At the east end of this bridge is Union street, a highway about at right angles to line of trusses. Three hundred feet west of bridge is another street.

The general plan for doing the work in this vicinity was as follows: Tracks 1 and 2, the two tracks which crossed the south half of bridge 381, were abandoned, all traffic being carried on the other two tracks. Then the concrete abutments of the new street bridges were built and the necessary fill was made to carry the abandoned tracks in their new proposed elevation. When this part was completed, the plan was to change traffic from the low to these elevated tracks, and then raise the low tracks to the new elevation. When the transfer was made the bridge had not been raised at all. The track to be placed to its new elevation, required a raise of 8 ft. at east end of the bridge. This could not be done at first on account of not allowing sufficient underclearance beneath portals and top of bracing. Six feet was the maximum raise possible, and this was given by carrying the two tracks across the bridge on cribbing. In building this false work, eight lines of 12 in. by 12 in. yellow pine were laid longitudinally along floor of bridge and arranged so that four would come under each track. This 12 in. x 12 in. yellow pine was in about 6-ft. pieces, placed under each bent, short pieces being used so as to save weight and time in handling when removed.

At intervals of about 10 ft. across the bridge and on these longitudinal pieces, bents were built by laying timber flatwise, one piece upon the other. Four pieces of 8 in. x 12 in. yellow pine were used, and one piece of 4 in. x 12 in. The top and bottom pieces were longer than the others in order that a track jack might be set in between. To carry from bent to bent, two 8 in. x 16 in. yellow pine stringers were laid under each rail. Seven-inch sawed track ties were used for the deck.

The approaches to the bridge were made on pile bent trestles. As before stated, this is a skew bridge, and in order to support the skew ends of the troughs when the bridge was being raised, lattice trusses were hung under each end of bridge parallel to the abutments and as close to them as possible. Two trusses were used at each end, lapping at the center. They were hung from the bottom chord of the trusses by heavy rods close to bottom of troughs, and the skew ends of the troughs wedged up on them.

In order to jack up the bridge, jacking beams were placed on each side of the shoe at each end of each truss. The bearing shoe is shown in Fig. 2. The jacking beams had a bearing on the bottom angle of the bottom chord. These jacking beams were built of 24 in. 100 lb. I-beams for center truss and 20 in. 85 lb. I-beams for outside trusses with cross diaphragms to prevent distortion. The beams were of sufficient length so that a jack could be placed under each end and clear the bottom of the shoe. An angle stiffener was placed at the point where the jack was to bear. The I-beam diaphragms were placed between these jacking beams and riveted to them, one in front and one behind the shoe. At two points where the end of jacking beam overhung masonry on account of the skew, the jack was placed under the diaphragm, which in these cases was made stronger.

Between top of jacking beam and bottom chord, three inch oak blocking was placed. Wooden struts were also driven between top and bottom angles of bottom chord to prevent bottom angles from bending.

The grillage for supporting the bridge when raised was composed of 10½ in. and 15 in. I-beams. These 15-in. I-beams were put up in sets of four each for outside trusses and five each for center trusses. A separator, made by riveting two pairs of angles to a web piece so that it resembled a section of a girder, was placed between each two I-beams and bolted to them with four bolts at the center of the beams. Holes were drilled in both ends of each beam so that a long bolt could be run through and each set bolted securely together. Gas pipe separators were strung on this bolt between I-beams. These I-beam grillages were built to slip in between the jacks and the ends come even with the edges of the shoe.

To raise the bridge twenty-four Watson-Stillman hydraulic jacks were used, four jacks being placed under each truss end. One hundred ton jacks were ordered for the center truss and 60-ton jacks for outside trusses, although about one-half of the number furnished were 100-ton jacks.

Preparatory to raising the bridge, sufficient oak and yellow pine, ranging from 1 in. x 12 in. to 8 in. x 12 in., was cut up into about 5-ft. lengths, and piled up close by jacking points for following up as the bridge was raised. Two men were selected to work each jack, and four men to handle blocking at each point. About 30 men were stationed to take care of track. In raising, one end of the bridge was raised at a time. Blocking was kept close up under bottom of shoe, to prevent damage in case of a jack failing. As a rule, 8-in. lifts were made, but at times smaller lifts were made, depending only on the amount of time to work before throwing track in service for passage of a train. On the completion of a lift, ¼-in. plates were placed on top of the blocking, and eight iron wedges, four on a side, were driven in between the plates and the shoe. These wedges were 4 ft. and 5 ft. long, 4 in. wide and tapered from 1½ in. to zero. They were driven in with heavy mauls, the object being to force the blocking to a bearing and take part of the load off of the jacks so that if any failed to release at the signal, no damage would be done to them.

After each 15 in. of raise the bridge was supported on the jacks for several minutes while the blocking was removed and replaced by a 15-in. I-beam grillage. Bottom grillage was placed with I-beams transversely to line of bridge, the second parallel to line of bridge, and so on. The top grillage was of 10½ in. I-beams, and was parallel to line of bridge. As each grillage was on top of each preceding one, it was bolted to it at each corner by ½-in. bolts.

The grillages of the center truss were too heavy to be handled by hand, and so it was necessary to erect a gin pole with block and falls to raise the pieces. The grillages to the outside trusses were handled by hand.

As each succeeding lift was made, blocking was placed under the jacks until the bridge was raised enough to allow a 15-in. I-beam to be used. Then the blocking was removed and two pairs of I-beams were substituted. Each pair consisted of two I-beams

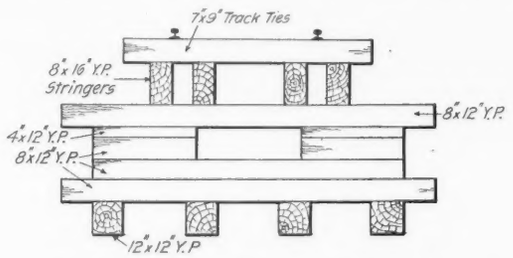


Fig. 1—Elevation Showing False Work.

somewhat longer than the grillage beams, so as to give a bearing for base of jack. Each pair had a 6-in. separator between. These were placed transversely to line of the bridge and parallel to the grillage, one in front and one behind the grillage, so that the base of the jack, when in position, had a good bearing. The long rods, which passed through ends of grillage, also passed through these additional I-beams, so that the whole was secured as one piece.

All of the transverse grillages had this same addition and were treated in the same way.

The longitudinal grillages had extensions for the jacks to rest on. Four pairs of I-beams 12 in. long were used for each grillage, each pair having a separator similar to those used in the grillages. Each extension was secured to the grillage proper by iron straps and bolts. As each piece was placed on top of each succeeding piece, it was securely bolted at each corner to the bottom piece, as in the case of the grillage.

While a lift was being made, the gang in charge of the track were removing blocking from the bents supporting it, and shimming up the rack and stringers so that the track could be used as soon as lift was completed. In all, the bridge was raised 7 ft. 2 in., and the raise was taken up by five 15-in. grillages and one 10½-in. grillage under each truss end. Forms were immediately built around these grillages and concrete and grout were run in. Masonry was then built up to its proper height.

As previously stated, the false work on the bridge was kept 2 ft. below the proposed elevation, because it was not possible to get under the top bracing with the tracks at the proper height. When all of the cribbing and false work had been removed from the bridge and the base of rail rested on top of the troughs, the track was given the remaining required raise with the bridge. In order to do this, it was necessary to raise the approaches at both ends. This was done on the west end by blocking up on top of the stringers of the pile trestle approach. On the east end, the framed bent trestle over Union street was jacked up bodily and blocking was driven under sills. This work was under the direction of G.

Fig. 2—Shoe of Truss, Together with Bottom Angle of Bottom Chord.

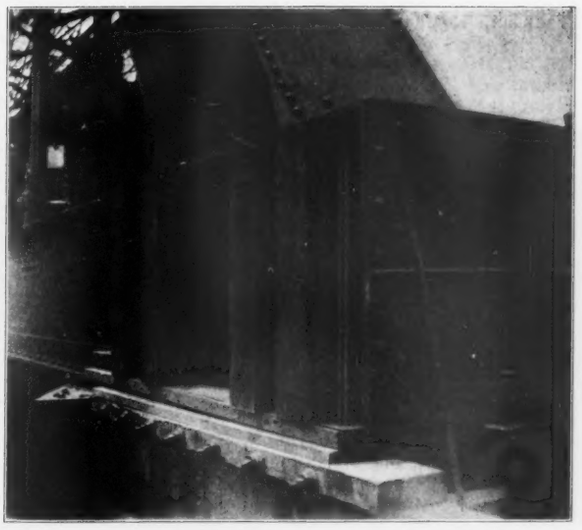


Fig. 3—Wooden Struts Between Top and Bottom Angles of Bottom Chord. Also Oak Blocking on Top of Jacking Beams.

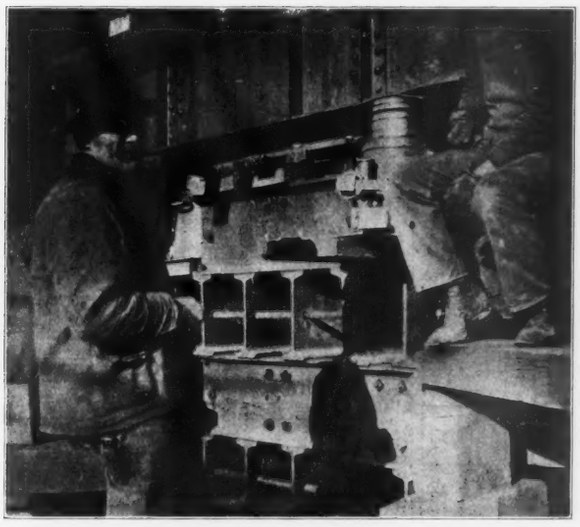


Fig. 4—Jacks and Grillages in Place. Also Iron Wedges Between Top Grillages and Shoe.

Fig. 5—Trestle Approach to Bridge.

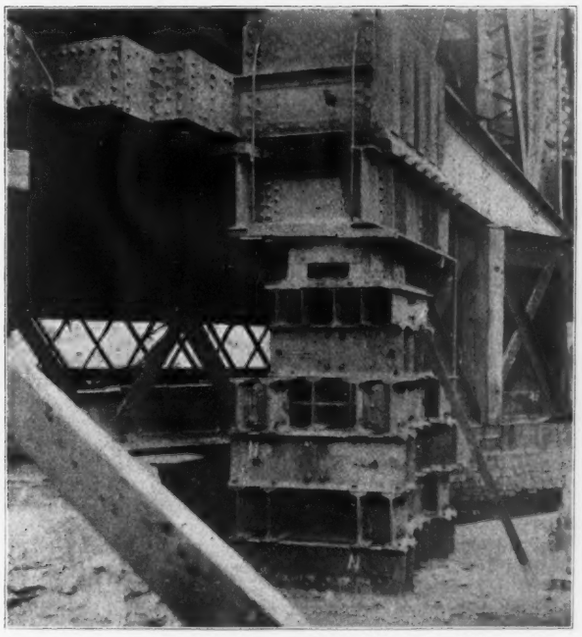


Fig. 6—Jacking Beams, Grillages in Place, and Trusses Supporting Ends of Troughs.

Fig. 7—Jacking Beams and Jacks in Position. Also Grillages and Trusses to Support Ends of Troughs.

W. Vaughan, Engineer of Maintenance of Way; A. W. Carpenter, Engineer of Bridges; C. E. Lindsay, Division Engineer, and N. W. McCallum, Supervisor of Bridges. The men worked ten hours per day, and two and one-half days were consumed in raising the bridge. Only one of the 27 regular trains which run daily within the ten working hours was held up or delayed. In addition to regular trains, it was necessary to clear up many times a day to allow yard pulls and shifting engines to pass. The work was completed without a mishap or accident of any kind. The total weight raised by the jacks was 1,100 tons.

Organization and Construction Methods Used on the Ivorydale Shops of the C. H. & D.

The Cincinnati, Hamilton & Dayton Railway completed the first of the present year terminal locomotive repair shops at Ivorydale, seven miles out from its terminal station in Cincinnati, on the main line of the road. These shops are intended to supplement the main shops at Lima, and, though not a large plant, are thoroughly modern in every respect. The accompanying ground plan (Fig. 1) shows the layout and dimensions of the buildings, etc. The plans and specifications for the entire equipment, except the coaling station, were prepared by The Arnold Company, Chicago, and this company also had the contract for the entire construction, including buildings and equipment. Inasmuch as this plant is a fair example of a project handled entirely through both the stages of engineering and construction work by one concern, the description in some detail of the methods by which this was accomplished, both in the office and field, is of interest. The following is taken from a bulletin of this company, also containing a detailed description of the plant.

The Arnold Company was instructed by the railroad officials to prepare a detailed report upon the capacity of the buildings and the facilities to be provided throughout the plant. This was done after a preliminary study had been made by the railway officials themselves. As a basis upon which to work, The Arnold Company was furnished with a plat of the ground available, together with information regarding the number of locomotives and cars to be handled at this division point and the relation of their operation to that of the complete system.

As is often the case in connection with railroad shop construction, the amount of money provided for the improvement was found by the engineering department to be somewhat limited. This made it necessary to omit some of the more improved machinery that is available to-day for the class of work contemplated in the plant and to substitute other devices at a less cost. In other words, it became necessary to a certain extent to engineer around a fixed sum of money somewhat less than might be wished, and this necessity resulted in the adoption of certain special provisions for making running repairs on locomotives and for taking care of bad order cars.

With due consideration to the above points, a block plan of the buildings and yards was prepared providing the necessary capacity and also adapted to the physical peculiarities of the site. This block plan, together with a description of the proposed improvements and accompanying estimate of cost, were presented to the officials of the railway company at a final conference and their approval of the plans and estimates was obtained.

In preparing an outline of improvements and an estimate of costs for the improvement a classification of the work was made which served not only for the estimates but for all correspondence, requisitions, accounts, progress of work and completed costs. This classification covered all the material and work proposed in the improvement and served not only to guard against omissions in any part of the equipment at the time the estimate was made, but also to keep the records of the progress of the work complete under each section of the classification.

The work was taken up in the following order: Detailed specifications were drawn for each part of the plant and bids were received from outside sources upon the work, but the estimate which was furnished by the Arnold Company with the completed plans and specifications, and intended to represent the cost of the completed construction work, closely conformed to the consistent bids. It is generally conceded that it is better policy to place the contract for the entire work in the hands of one reliable concern than to let various parts of the work to different bidders, who, on this class of work, would aggregate a large number. The time required for the completion of a plant of this character is also largely modified by placing the control under one head. Each class of work follows in its natural sequence, and in a great many instances several classes of work are carried along together which under ordinary circumstances would follow consecutively. The necessity for early completion of the Ivorydale plant was so urgent that the railroad company considered it expedient to have the entire construction carried on by the Arnold Company, who planned the complete plant. They, being thoroughly familiar with all the requirements, were able to immediately place orders for the various materials and having available an efficient organization familiar with this class of work, were shortly ready to begin construction.

The rapid and efficient construction of the Ivorydale shops is due in no small measure to a few simple and direct principles governing the relation between the main and the construction offices. The construction office is advised as to the material ordered and as to the delivery of this material. The home office is advised as to the receipt of material on the job as well as to the progress of the construction work and any reports and advices as to the labor situation. To accomplish the former copies of contracts for apparatus and orders for material are sent to the superintendent in charge of construction. Such reports and orders contain exact information as to the material covered by them as well as to the time at which this material is expected to arrive on the work. A card system, in which are entered all orders and contracts, is used in the home office and is designed to follow up and secure prompt delivery of material and apparatus. In case of any changes in time of delivery of material the construction superintendent is advised in advance, and is thus in position to make any changes necessary in his programme. The importance of promptly delivering the material on the job cannot be overestimated, and the value of a system that will provide for the delivery of the materials on the job in accordance with an approximate schedule previously arranged for will appeal to all interested in construction work.

Practically all of the material is ordered by the home office. In case, however, it is more advantageous to order small quantities at the seat of the work such orders are issued by the superintendent, a copy of all such orders being sent to the home office, after which they are recorded and handled in all respects similar to orders issued from the office. Records of all material received on the job are kept by the superintendent in the form of a material report. These

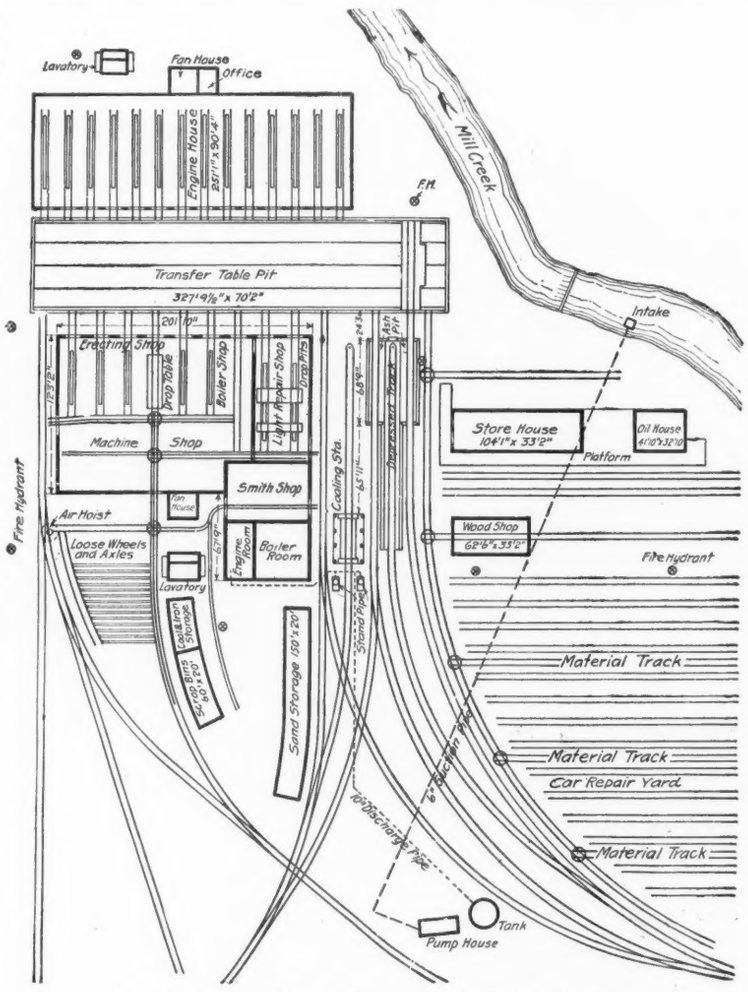


Fig. 1—Ground Plan of C. H. & D. Ivorydale Shops.

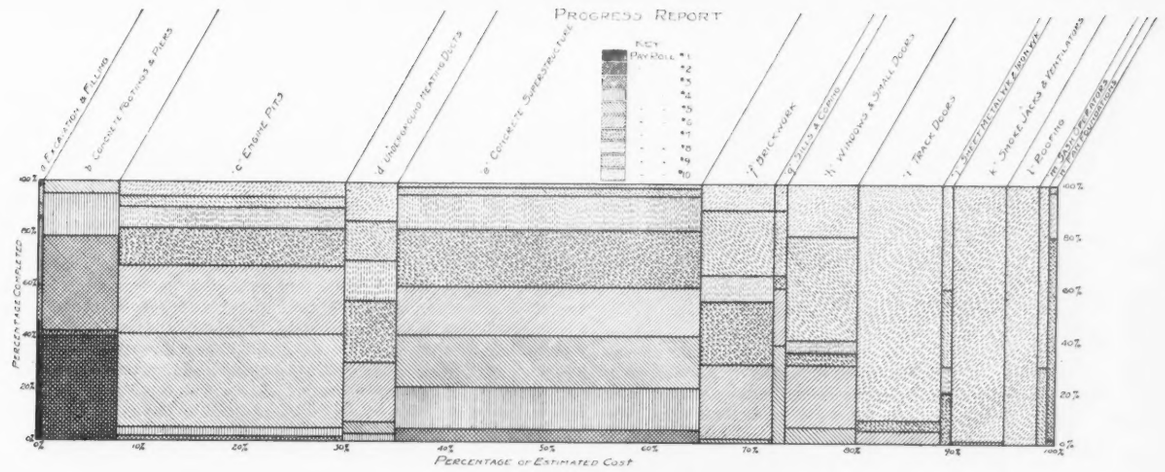


Fig. 2—Method of Reporting Progress of Construction Work.

reports are written out in a duplicate book as each shipment is received, and one copy is sent without delay to the main office. This serves to keep the home office very closely in touch, so far as the receipt of material is concerned.

In construction work consisting of a great many items, such as will be found in railroad shops, it is very desirable to know with a fair degree of accuracy the exact progress of the work. Certain lines of the work, such as the delivery and installation of machinery, are dependent upon the progress of other work such as the completion of the buildings and foundations. In order that such information may be always at hand progress reports from the work are received at stated intervals, usually two weeks apart, giving in detail the progress of the work under each classification head. This information is kept in form for convenient reference and is useful in a variety of ways. Not only does it keep the engineering force in touch with the progress of the work, making it possible to more efficiently make such provision as will insure the work coming in proper sequence, but also providing the information necessary to make decisions as to changes in detail, in case such are found necessary after the work has been begun. These progress reports, together with a record of moneys expended for material and labor at any date, give timely information as to the actual cost of the work as compared to the estimated cost. As such reports are made on the work under each classification heading, any variation of the cost from the estimate is at once detected. This is of importance to the contractor who proposes to complete a certain improvement within a definite estimated cost.

Wherever it is possible curves or diagrams are used to represent the condition of affairs of which record is to be kept. A chart showing the progress of the work on building construction is easily made and shows very clearly at a glance the exact condition of the work at any time. Such a chart is shown herewith (Fig. 2), which indicates the progress of the work on the engine house building at the time of completion. On this chart the base represents the total estimated cost and is divided into the various classifications covering the cost of this particular building. In this case these

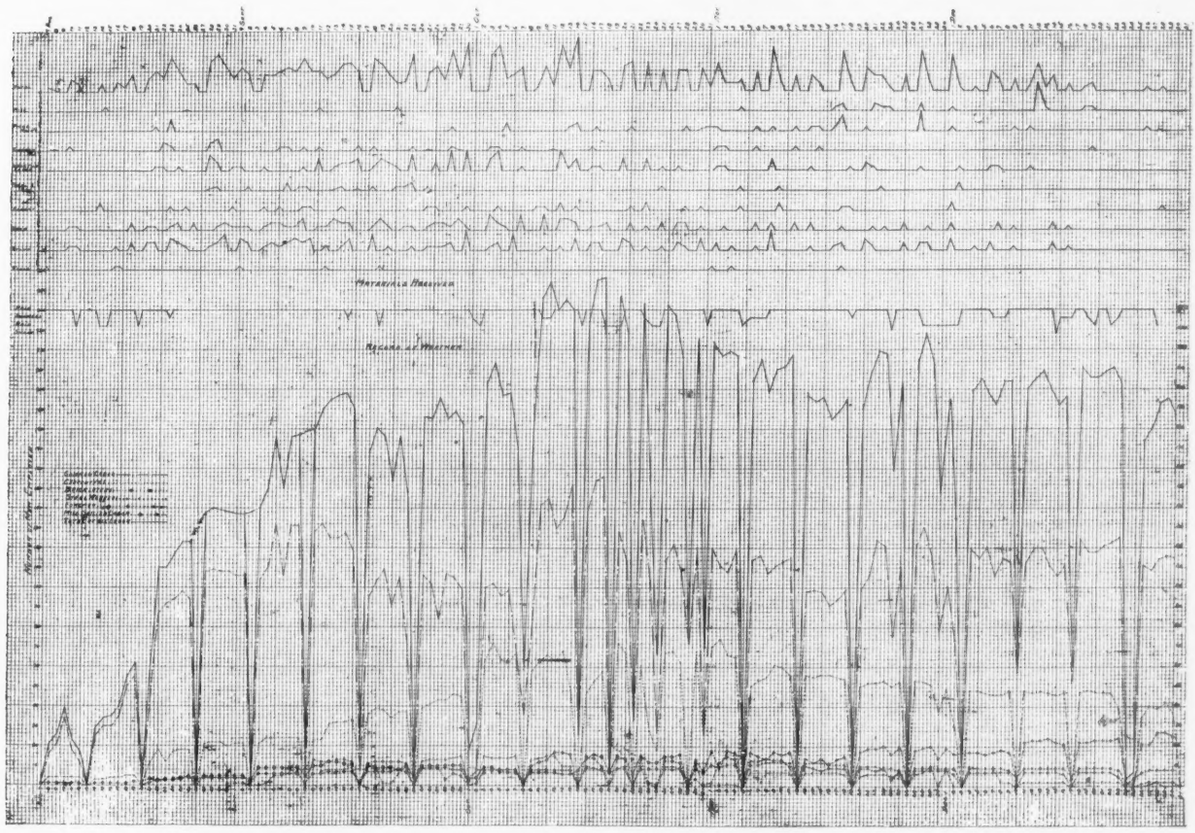


Fig. 3—Record Chart of Construction Work.

classifications cover excavation and fill (about ⅔ per cent. of the total cost), concrete footings and piers (about 6⅔ per cent. of the total cost), etc., the other divisions, such as engine pits, underground heating ducts, concrete superstructure, etc., making up the total cost of the building. At the end of each two-week period the total expense that had been incurred during the two weeks previous is plotted under each classification head, and this area on the chart indicated in such a way as to designate the progress made during the particular two-week period in question. A glance at the chart will show the total amount completed under each classification represented on the chart at the time the last entry was made, as well as the amount of work that was done under the various classifications during each period considered.

Moreover, it is at once evident that during the period of the fifth payroll nearly 40 per cent. of the work on the engine pits, 20 per cent. of the concrete superstructure, 2 per cent. of the brick work, 40 per cent. of the sills and coping, 6 per cent. of the windows and small doors was completed, and no work was done on the sheet metal and iron, none on track doors, smoke jacks and ventilators, none on the roofing and none on the sash operators and foundations. In other words, these progress reports become the graphical history of the job. After having made out the necessary reports covering both the material and the labor that have been used on the work, it is a very simple matter to embody these results in a chart. A copy of this chart is then sent to the main office where it remains until the time for the next report, at which time it is sent back to the job for the additions that have occurred during the period.

In addition to these some other curves showing the progress of the work are shown (Fig. 3). These contain in graphical form a record of the number of workmen employed on the work at all times, together with information as to the number of carloads of material received, the weather conditions and other matters of interest. It will be seen that within three weeks after construction work was started about 125 men were at work on the job, and this number was increased at the end of the fifth week to about 200 men, at which point the working force remained constant until very nearly the completion of the work.

Progress photographs are taken of the work at stated intervals, in the case of the Ivorydale shops about two weeks apart. These show at a glance not only the general progress of the work, but many construction details as well which are of interest and value. These photographs are of a standard size and mounted on cloth so as to be bound in convenient form for reference. All the reports just referred to, viz.: the progress reports, charts and diagrams, while very easily obtained and requiring but little work in their preparation, supply a great deal of valuable information, and are of worth far exceeding the trouble and expense contracted in securing them.

Although every facility is provided for keeping the main office and the construction office in close touch, it should not be understood that the engineering is done at arm's length, and that all plans and specifications are devised and completed by an engineering force in the office, to be sent down to the construction superintendent on the job for his execution. A competent engineer is in charge of all construction work and spends a certain amount of time in the field, thus putting him in close touch with the situation and enabling him to more efficiently direct the detailed engineering work that is done in the main office.

The salient features in the method used by the Arnold Company for handling a proposition such as the Ivorydale shops, when briefly stated, are as follows:

(a) A general survey of the improvement proposed, together with data from the railroad company as to the facilities and functions to be provided in the improvement, and as to the amount of money available for the improvement.

(b) A complete report upon the plant proposed, together with an estimate of cost; such report and estimate to be approved by the railroad company's officials. This estimate is subdivided in accordance with a predetermined classification, which classification will be adhered to throughout the progress of the work.

(c) The preparation of detailed specifications and plans covering the entire work to be submitted to the railroad company for their approval.

(d) The purchase of all material and the organization of the necessary force required for the construction of the complete property under one head.

(e) The prosecution of the work under the direction of one responsible engineer, and the use of a system which keeps the main and construction offices in close touch during the progress of the work.

(f) The furnishing to the railroad company of a complete installation in accordance with their definite requirements, and at the same time relieving them of all detail work in connection with the improvement. In short, allowing them to contract for a complete plant to perform a definite service, rather than necessitating their entering into a large number of contracts for various parts of the plant and assuming the responsibility and detailed work incident to bringing these separate contracts together as a completed whole.

Status of M. C. B. Standards for the Protection of Trainmen.

The results of the letter ballot of the Master Car Builders' Association on matters referred for such action at the last convention have lately been announced by the Secretary and show that subject No. 4, "change in text relating to handholds," was rejected, while No. 5, "location of handholds on roofs of box or stock cars," was adopted. From the foregoing results, and from correspondence received from members on various phases of the subject, it was plain to the Committee on Revision of Standards and Recommended Practice that the standards for protection of trainmen were in an unsatisfactory state, and an immediate investigation of the matter was decided on. A careful examination has therefore been made and an analysis and recommendations prepared for submission to the Executive Committee of the Association, suggesting that early consideration be given the matter. Through the courtesy of the Chairman of the Committee on the Revision of the Standards and Recommended Practice, Mr. T. S. Lloyd (C., R. I. & P.), we are permitted to print this report and recommendations to the Executive Committee. The matter was also presented to the September meeting of the Western Railway Club on Tuesday of this week by Mr. C. A. Seley (C., R. I. & P.), who made the investigation for the committee. It is desired by the committee, and the Secretary of the Association, that all other railroad clubs take up the subject at an early meeting and discuss it thoroughly. The report is as follows:

In view of some uncertainty in interpreting the M. C. B. standards for the protection of trainmen, as noted in some recent correspondence, particularly in reference to the application of steps and handholds, consideration is respectfully desired of the following argument.

A general examination of the standards of the M. C. B. Association for the Protection of Trainmen shows a number of inconsistencies, as between the written text and the drawings on M. C. B. Plate 19, these discrepancies running back for several years in some instances. The earliest action of the Association in reference to this matter was taken in 1888, but this was considerably amplified and made Recommended Practice in 1893. In the 1896 Proceedings is found the basis of present practice. A special committee of 11 members, under the direction of the Executive Committee, presented a report that was embodied in circulars sent to all members for an informal ballot. (See 1896 Proc., pages 463-6.) The formal report of this committee, made at the convention of 1896 (see Proc., pages 304-311 and 328-335) with some slight subsequent modifications has been recognized as conforming to the intent and purpose of the law as expressed in the Safety Appliance Acts.

In 1902, by letter ballot the matter was advanced from Recommended Practice to Standard Practice. In 1905 Plate 19 was revised, adding notes, etc., but no change of the text was authorized. In 1906 the Committee on Standards recommended some changes of text which were discussed and referred to letter ballot, but the result of this ballot has been to defeat the proposed changes of text and the entire matter is therefore as shown in the 1905 Proceedings, as regards text and drawings, except the change of position of roof handhold, which has carried in the ballot and is included in this argument.

The idea of the Interstate Commerce Commission in reference to this matter, as explained by the Chairman of the Committee on Standards (see page 94, 1905 Proc.) is "to have grab irons on all cars in a common place, that is, regardless of whether it is a flat car, a gondola or a box car, that the trainmen may expect to find a grab iron in a certain place on any car." This should also apply to steps and the principle expressed should rule on all cars which may be considered regular equipment.

Cars which may be classed as "special equipment" may require a modification, but these cars should have the regular equipment of steps and handholds common to their general type, and may have such additional equipment of steps and handholds as their owners may deem necessary as a measure of safety. The Safety Appliance Acts do not specify the number and location of handholds, and it has been repeatedly stated that the practice and standards of the M. C. B. Association are the guides of the Interstate Commerce Commission's inspectors in enforcing the law. The "law," in this connection, and as referred to in Rule 39, is therefore the standard practice of the Association and should be clear and unmistakeable.

In endeavoring to arrive at conclusions in regard to each point, this analysis will give prior authority to the written text in case of disagreement between the text and the drawing, believing that the expressed intention should rule rather than one implied by drawings that can be variously interpreted. This is in accordance

with a well-known principle of law which cannot be successfully disputed.

As regards the matter of steps, the paragraph having that caption is considered authoritative regarding the number of steps on cars. In part this reads, "Two substantial steps . . . to be fastened, one to each side sill, next to the corner of the car to which the ladder is attached, on cars having ladders, and to diagonally opposite corners on all other cars . . . etc." The omitted and remaining portions of this paragraph do not modify these fundamental principles, which appear in the Proceedings back for several years. Nothing inconsistent therewith is found in the section under the caption of handholds, if reference to the drawings is omitted. It is a fact, however, that the drawings as shown on Plate 19, ever since 1896, do not agree with the text and a number of changes were made in the 1905 sheet which are not included or explained by the text.

Back of 1905, the cuts show steps on both sides of the same ends of drop end gondolas, tank and flat cars, whereas they should be shown only on left-hand side of end as on box, stock and fixed-end gondolas. These views are plainly intended to show one end only in each view, and to be consistent with each other and with the principle expressed as to the number of steps on cars, they should have been eliminated.

The 1905 revision of Plate 19 adds a lot of text to the views evidently intended for explanation, but some of it is manifestly not in accord with the authorized description, pages 456-7-8. Prior to 1905 the car views were marked A1, A2, A3, etc., but these designations are omitted in the 1905 Sheet 19, and as the views are still described in the text by these symbols, it would seem as though the Sheet 19 of 1905, as regards standards for the protection of trainmen is completely invalidated, or at least very incompletely supplements the authorized text.

This sheet, however, was submitted as a part of the report of the Committee on Standards, was received and ordered submitted to letter ballot, was passed by a large majority and is therefore a standard, in so far as it is consistent with the description. It was repeatedly stated in the discussion of the committee report (pages 91-101) that the changes of the drawings were merely the addition of explanatory notes and of cuts of a high-side gondola, not before shown. The committee's report also included the following: "In the construction of special equipment, grab irons or handholds should be placed on both ends of the car; sill steps and ladder rounds at the B end of the car. If the construction is such as to add an element of safety, they should also be placed on the right-hand side of the A end of the car." Inasmuch as the foregoing has to do with "special" equipment which has already been considered in this argument, as there is no authoritative ruling as to what may be considered special equipment, and as there has been no provision for the incorporation of the committee's recommendation in the descriptive text, either at the 1905 or 1906 conventions, a new paragraph is hereinafter proposed in lieu thereof, to be inserted in the descriptive text.

In discussing this matter with the Secretary of the Association he suggests that if revision of sheet 19 is made, that the entire sheet be given up to this subject, and other matters shown thereon be transferred to some other sheet; also that the views be made larger and clearer, and that the sides at both ends be shown instead of showing only ladder ends.

It is believed that for consistency, to have plate M. C. B. 19 properly represent what is described and to have the description agree with the plate and also include what is not now included, although common and general practice in some respects, that the text and the drawings should be changed at the earliest possible moment, in view of the importance of the matter to the railroads as regards their relation with the Interstate Commerce Commission, and also to establish a safe and readily understood instruction. To that end the following suggested revision is submitted for your consideration.

PROTECTION OF TRAINMEN.

SHEET M. C. B.—19.

Introductory paragraphs (1) (2) O.K.

Position of Brake Shafts.

O. K. (The word "about" being put before "20 inches" in last line, in accordance with action last year. Also add "Proc. 1905 and 1906.")

Running Boards.

Owing to the abolition of buffer blocks in 1904, reference to them in this paragraph is improper. It is proposed to eliminate the words, "so that the end of running boards shall not be more than 6 inches back of face of buffer block." It is suggested that location of end of running board be referred to a committee at the next convention.

Steps.

O. K.

Ladders.

First four lines—O. K. The semicolon after the word "Car" to be changed to a period and the balance of the sentence changed to agree with the action of the 1906 convention, as follows: "Car. Each car to have a handhold on roof directly over top of ladder and running parallel with the side or end of car on which the ladder is located; these handholds to be placed about 15 inches from the edge of the car and of a length suitable to the construction of the car." Last sentence, "When iron ladders are used and placed," etc., (lines 8 and 9) O. K.

Proceedings 1902, 1905, and 1906.

Handholds.

First paragraph O. K. (Reproduce drawing as in 1905, except roof handhold, which should be parallel with end. Notes are O. K. Mark A—1.)

Second paragraph, O. K. (Reproduce drawing as in 1905. Mark A—2.)

Third paragraph, O. K. (Reproduce drawing as in 1905, except roof handhold, which should be parallel with end. Notes are O. K. Mark A—3.)

Fourth paragraph. The language of the fourth line, in reference to end grabirons being two on right side of end, is manifestly wrong. It is proposed to revise this to read same as the second paragraph in this respect and as shown on drawing A—2 and A—4, the revision being as follows: First two lines and to period in third line, O. K. Next sentence to read, "They should also be provided with two horizontal grabirons or handholds about 24 inches long on each side of end of car, not less than 18 inches," etc., etc. Balance of paragraph O. K. While this is the language that has prevailed for years in the second paragraph, and is generally understood to mean, located "one" on each side of end, the word *one* is not used although it would make it clearer.

(Reproduce drawing 1905. Mark A—4.)

In order to authorize and use the note under box and stock car views A—1, A—2, A—3, and A—4 of sheet 19, a new paragraph is proposed, to follow the fourth paragraph on handholds, as follows: "All other classes of house cars, such as refrigerator, furniture cars, etc., if constructed with projecting end sills, are to have ladders, sill steps and handholds as described for box and stock cars, and as shown in Fig. A—1 or A—2. If not constructed with projecting end sills they are to have ladders, sill steps and handholds as described for box and stock cars, and as shown in Fig. A—3 or A—4." (Reproduce note.)

Fifth paragraph, O. K. (Reproduce drawing as in 1904, omitting step on right side, omitting coupler. Show deadwood and uncoupling rod as left-hand grabiron. Make title as in 1904.)

Sixth paragraph. It is believed that paragraph six should be revised by leaving out the words "high side" in the first line. Paragraph five refers to "all gondolas with drop ends" and if paragraph six could be made to read "all fixed end gondolas," more inclusive language would be used and the situation made clearer. It is thought best to suggest authorization as an alternate, the use of a suitable number of horizontal handholds on the sides of high-side gondolas, the argument being that it presents the same arrangement as on box and similar cars.

The original paragraph authorizes the side, vertical handholds which are not shown on the 1905 sheet, although so shown in former years to 1896, and it is believed that this should be restored. The committee report on the recommended change of text also cuts out the use of brake-step bracket as a handhold. This is a change of practice heretofore authorized for many years and should be retained.

Attention is called to the language of the last five lines of paragraph six, as being recommendatory rather than mandatory as to necessity for the end vertical handholds. If the alternate plan of using the horizontal handholds is contemplated, the end vertical handholds may be deemed unnecessary, and they have been omitted in the suggested revised drawing. This is in accordance with the 1906 sheet which shows the horizontal handholds and is consistent with the text as to mandatory requirements. It is therefore proposed to have the sixth paragraph read as follows: "All fixed-end gondolas should be equipped with a vertical grabiron or handhold over steps on the sides of the car, about 24 inches long, the lower end to be placed about 6 inches above the floor of the car; or with a suitable number of horizontal grabirons or handholds, about 24 inches long, over each step; and two horizontal grabirons or handholds on each end of car, about 24 inches long, 4 inches from the outside of car and not less than 18 nor over 30 inches above center line of drawbar; exception to be made where the car is provided with a brake step, in which case the bracket of the brake step can be used as a grabiron on that side of end of car, as shown on Fig. A—6, Sheet M. C. B. 19. "It is also recommended that, etc., etc.," and last four lines, O. K. (Reproduce drawing A—6, as in 1904, omitting coupler and right-hand side handhold. Add alternate low side car, omitting brake step, showing two end handholds. On high-side car omit platform on side view, show brake step. Also show alternate high-side car, showing same as B end on 1905 sheet, but omitting the top handholds and the handholds and step on right side. Show brake step. Title as in 1904.

Seventh paragraph, O. K. (Reproduce drawing as in 1905, but omit steps on right side of end views. Notes, O. K. Change title to read "Tank Cars, A—7."

Paragraph eight. The section on Steps requires two steps on all cars, but the present language of the eighth paragraph implies that some flat cars have none. It is thought wise to recommend revision of this paragraph, eliminating the words "and if not equipped with steps," etc., so that the arrangement common to gondolas and other cars will also be applicable to flat cars. The revision recommended is as follows: "All flat cars to be provided with horizontal grabirons or handholds, about 24 inches long, over steps near end of car where coupler unlocking rod is located, and two end grabirons or handholds, about 18 inches long, etc., etc., lines 5, 6, 7, 8 being O. K. (Reproduce drawing as in 1905, except last end view, which should show uncoupling rod and deadwood, one step only on left side, two handholds under end sill. Notes, O. K. Make title "Flat Cars." A8.)

It is proposed to introduce a new paragraph following the eighth, which shall cover the general question of handholds on regular and special equipment, as heretofore referred to, reading as follows: "Cars of other types of construction, not covered specifically in foregoing paragraphs of this section and not shown by the drawings on M. C. B. Plate 19, Standards for the Protection of Trainmen, may be deemed of special construction, but shall have the complement of grabirons or handholds and steps and ladders as is required for cars of the nearest approximate type, and such handholds shall be considered as required by the Rules of Interchange."

Paragraph nine, O. K.

Paragraph ten. This paragraph is not consistent with foregoing paragraphs in reference to specified clearances. The paragraph on Ladders specifies a clearance of 2½ in. Paragraph five, of the section on handholds for drop-

end gondolas specifies a 3-in. clearance for the handholds on underside of end sills. Paragraph seven, on tank cars, and paragraph eight, on flat cars, specify these under end sill handholds "same as for drop-end gondolas," which would carry the idea of a 3-in. clearance. It is proposed, therefore, to change the paragraph so as to define the clearance in accordance with foregoing specifications, as follows: Handholds on face of end sills should have at least 2 inches clearance behind them, and all other handholds should have at least 2½ inches clearance behind them, except grabirons or handholds located on underside of end sills, which should have a space not less than 3 inches between them and the end sill."

Paragraph eleven. This paragraph is not consistent with foregoing paragraphs relative to end handholds on gondola, flat and tank cars, where grabirons or handholds 18 inches long are permitted, although a greater length may be possible. It is proposed therefore to revise this paragraph, and while doing so it is thought wise to include and validate the quite general custom of using the uncoupling rod as an end sill grabiron, when it has the proper clearance behind it as required by the preceding paragraph. Revised paragraph eleven is proposed as follows: "All handholds should be made of iron not less than ⅝-inch diameter: handholds on sides and ends of cars should be about 24 inches long in the clear, except end sill handholds, which may be from 18 to 24 inches long: provided, also that the coupler unlocking rod, if properly located and having 2 inches clearance between it and the car, will be a suitable end sill grabiron or handhold."

Paragraph twelve: Add "Proc. 1905, 1906."

The Ventilation of Tunnels.*

In 1904 the writer presented to the International Engineering Congress, Paper No. 43, on the "Ventilation of Tunnels." Since that date improvements have been made in some of the tunnels and subways referred to, which are worthy of note, and the writer has obtained certain additional data, as to the condition of the air in some subways and tunnels in Europe, which are valuable for comparison in determining good practice.

Gallitzin Tunnel.—The ventilating plant at Gallitzin Tunnel, west of Altoona, on the main line of the Pennsylvania Railroad, was referred to in that discussion as being of the same type as that of the Elkhorn Tunnel, on the Norfolk & Western Railway, and as being practically completed at the date of the discussion.

This ventilated tunnel is 3,600 ft. long, and is built for a single track, being 17 ft. wide and 20 ft. 5 in. high, and is lined with concrete. Its sectional area is 324 sq. ft., and the cubical contents of the whole tunnel are 1,166,400 cu. ft. There is an ascending grade of 0.5 per cent. from the east end through the tunnel, but the east approach is on a heavier grade, so that westbound freight trains generally have a pusher engine at the rear of each in passing through the tunnel.

The accompanying drawing shows the general arrangement of the ventilating plant and all important details, its location being at the east or lower end of the tunnel.

With fans making 145 r.p.m. the observed flow of fresh air through this tunnel from east to west is at a velocity of 1,780 lin. ft. per min., equivalent to 576,000 cu. ft. per min. As usually operated, these fans make 130 r.p.m., while freight trains are in the tunnel, and the velocity of the air in the tunnel is 1,550 ft. per min., which results in 502,000 cu. ft. of fresh air being delivered through the tunnel each minute. With the fans running at this speed, the tunnel is cleared directly after the exit of a westbound train. Excepting when freight trains are in the tunnel, the fans run at from 40 to 60 r.p.m.

There are, as shown, two 8 x 16-ft. fans, one on each side of the track, each operated by a direct-coupled engine of about 200 h.p., the total rated horse-power of the plant being 400. This ventilating device was put into regular operation in April, 1905.

St. Clair Tunnel.—The St. Clair Tunnel, on the Grand Trunk Railway, with its insufficient ventilation, is described in the *Transactions* of the American Society of Civil Engineers, Vol. LIV., Part C, p. 529.

On Oct. 9, 1904, six employees of the railroad were killed in this tunnel by gas and smoke from a locomotive while necessarily standing in the tunnel on account of a break-in-two of a train. This accident is fully described in the *Railway and Engineering Review*, Oct. 15, 1904.

In lieu of installing a system of ventilation, the Tunnel Company has during this year contracted for the electrical operation of this tunnel by methods described in detail in *Engineering News*, Jan. 18, 1906.

This will remove all danger from such causes, and very greatly reduce the discomfort of persons in the tunnel; but, nevertheless, in the future some means of artificial ventilation may be found desirable, as in the case of the Mersey Tunnel, Liverpool.

Park Avenue Tunnel, New York City.—The work of providing for electrical operation, which was undertaken partly for the purpose of improving the ventilation, is rapidly progressing. The reasons given are, briefly: Improvement of ventilation, greater safety in operation, and increased capacity.

Simplon Tunnel.—This tunnel, which is 12.33 miles long, and is constructed for a single track, with one passing siding at the center, was completed early in 1906, and was formally opened on May 19, 1906. When the writer visited this tunnel, in the summer of 1905, a steel sliding door at each portal was arranged so as to be raised and lowered by electric power. The plan at that time was to lower the steel door after the entrance of a train and to force fresh air from the fans at that end of the tunnel into and through the tunnel with considerable pressure. The adoption of electricity as the power for handling trains through this tunnel has greatly simplified the problem of ventilation.

The St. Gothard Railway Tunnel.—This steam-railroad tunnel is 9.3 miles long, is located on light grades, and is double-tracked. It has a large section, the area being 603 sq. ft., or approximately 3.2 times the area of two trains occupying the tunnel section. The cars of trains while in the tunnel are lighted by gas.

This tunnel is ventilated by a Saccardo plant, at Goeschenen, at the north end of the tunnel. It consists of two large fans operated by water power. Ventilation is secured by reducing the area of the tunnel section by about 38 per cent. near its northern end. For comparative purposes, a sample of air was taken by the writer from a car of a northbound train, running 30 miles per hour, at a point about three miles from the south end. The temperature was 82 deg. Fahr., and the air contained 10.19 parts of carbonic acid gas per 10,000 volumes. The measured quantity of fresh air which the writer found to be passing into the north end of the tunnel from the ventilating plant was 413,000 cu. ft. per min. at a velocity of 686 ft. per min.

Special attention is called to the large area of the tunnel section relatively to the cars used, and the consequent small velocity and volume of fresh air used in ventilation. The other favorable condition in this tunnel is the light grade throughout its length, so that the coal consumption of locomotives while in the tunnel is kept low. At the measured velocity of the ventilating air current, a period of 1 hr. and 12 min. is required to change the air in this tunnel.

The Berlin Elevated & Electric Railway.—This electric railroad is largely above ground, but there are short sections of subway, having a rectangular section of about 231 sq. ft., in which single span there are two tracks. The stations are roomy, and each is provided with two large stairways leading directly to the surface, thus insuring fair ventilation. The air in these short subway sections was noted by the writer as being good.

Metropolitan Railway, Paris.—The Metropolitan Underground Railway of Paris is a double-track arched tunnel, nicely lined, and built as close to the surface of the streets as practicable. It is electrically operated. The stations are comparatively close together, averaging less than 1,700 ft. apart. The two tracks are in one span, the area of the tunnel section being 315 sq. ft. This section is greatly enlarged at each station, thus providing in one span ample room for platforms. The area of the tunnel is approximately twice that of the two trains occupying the tunnel section.

This railroad is specially notable for the large tunnel section, roomy stations at short distances apart, and the provision of two large stairways at each station, giving good direct outlets for ventilation. Two short portions of two lines of this road were examined by the writer. A sample of air taken at 7.40 o'clock on a bright morning, from a Metropolitan Railway car, between Palais Royal and Alma Stations (between which there were five stops at intermediate stations), temperature 70 deg. Fahr., contained 2.94 parts carbonic acid gas per 10,000 volumes of air, the outside air at that time containing 1.76 parts.

The Mersey Tunnel, Liverpool.—This tunnel is two miles long, has a section of about 425 sq. ft., and is provided with two tracks. It is now electrically operated, and is well ventilated by large fans. The air in this tunnel is now good. A sample taken by the writer from a car in this tunnel, July 24, 1905, contained 4.70 parts of carbonic acid gas per 10,000 volumes.

The District Railway, London.—The District Railway is a double-track subway, with its grade level generally as close as practicable to the streets above it, and with frequent openings to the surface, in addition to having stations approximately one-half mile apart. It is operated by steam, but it is being gradually electrified, primarily to secure better ventilation.

For comparative purposes, the writer quotes a test, made in 1902 for the London County Council, which showed that the air in a car contained 15.1 parts of carbonic acid gas per 10,000 volumes. A sample of air taken from a District Railway car by the writer, between Mansion House and Temple Stations, on a fair day, June 27, 1905, at 4.25 p.m., temperature 76 deg., contained 11.27 parts of carbonic acid gas per 10,000 volumes, the outside air at that time containing 3.55 parts.

Metropolitan Railway, London.—The Metropolitan Railway is similar to the District Railway in construction and operation, and is also being gradually electrified, for the same reasons.

A test made in 1902 for the London County Council showed that

*A paper presented before the American Society of Civil Engineers, Sept. 19, 1906, by Charles S. Churchill, Chief Engineer, Norfolk & Western, and printed in the *Proceedings*, Vol. XXXII., p. 440.

the air in a car on this road contained 28.8 parts of carbonic acid gas per 10,000 volumes. A sample of air taken from a Metropolitan Railway car by the writer, between Gower street and Portland Road Stations, on a very clear day, July 24, 1905, at 12.40 p.m., temperature 74 deg., contained 14.07 parts of carbonic acid gas per 10,000 volumes, the outside air at that time containing only 1.75 parts.

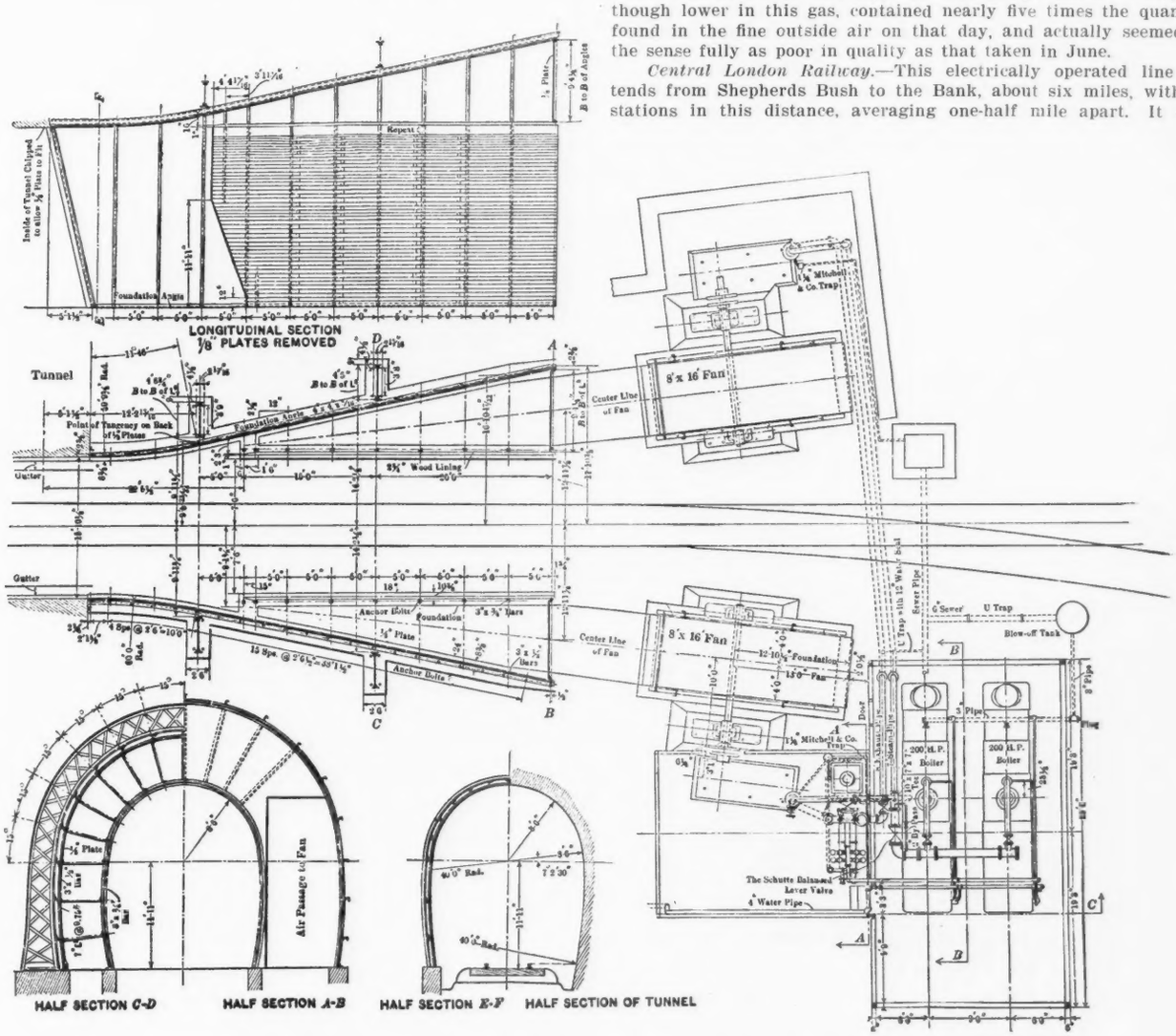
City & South London Railway.—This electrically operated line extends from Angel to Clapham Road, about six miles, with 13 stations on the entire line, the average distance apart being one-half mile. It consists of two single-track tubes, the inside diameter of each being 10 ft. 6 in. They are deep below the surface of the ground. As these tubes are small, the clearance around the trains is very narrow. The tubes are connected by small passages at the stations and by cross-overs near a few of them. The area of each tube is 86 sq. ft., the area of both tubes being, therefore, 172 sq. ft.; and one tunnel section equals about 1.4 times that of a train. The quantity per station is clearly insufficient to balance the vitiation of the air by the occupants of a train.

Tests made in 1902 for the London County Council showed that there were 14.2 parts of carbonic acid gas per 10,000 volumes of air in an empty carriage. A sample of air taken from a City & South London car by the writer, between London Bridge and Moorgate Stations, on a fair day, June 27, 1905, at 3.45 p.m., temperature 74 deg. Fahr., contained 11.78 parts of carbonic acid gas per 10,000 volumes, the outside air at that time containing 3.55 parts.

Another sample, taken on July 24, 1905, from a car of the same road between Elephant and Castle Station and London Bridge Station on a still brighter day, at 9.25 a.m., temperature 69 deg. Fahr., contained 8.69 parts of carbonic acid gas per 10,000 volumes, the outside air at that time containing only 1.75 parts.

The sample taken in June shows that the car air contained a little more than three times the quantity of carbonic acid gas found in the outside air on that day, while the sample taken on July 24, though lower in this gas, contained nearly five times the quantity found in the fine outside air on that day, and actually seemed to the sense fully as poor in quality as that taken in June.

Central London Railway.—This electrically operated line extends from Shepherds Bush to the Bank, about six miles, with 13 stations in this distance, averaging one-half mile apart. It consists of two single-track tubes, each 11 ft. 6 in., minimum inside diameter, connected by passages at the stations, also by six cross-overs in the entire length. The area of each tube is 100 sq. ft., the area of both tubes being 200 sq. ft. The cubical contents of the entire railroad tubes are equal to about 6⅓ million cu. ft.



General Plan of Ventilating Plant at the Gallitzin Tunnel, Pennsylvania Railroad, Completed in 1905.

travel on this line is not as heavy as on some others, notably the Central London Railway. It is not ventilated artificially, and the air is not as good as in other tubes of the electric railroads in London. The only natural ventilation is through a stairway and generally three lifts at each station. The stairway has a minimum opening of from 35 to 40 sq. ft. One lift contains about 2,500 cu. ft., and has a capacity of about 50 persons. During ordinary light traffic only one of these lifts is required per train.

The draft produced in the tunnel by an approaching train lasts only 1 min., and amounts to only about 17,000 cu. ft. The draft that follows a train lasts about ½ min., and amounts to only about 8,000 cu. ft. At the stairway of Borough Station, at the time of the passage of a train, a down-draft was noted for 1 min., equal to about 7,000 cu. ft. of air, followed by an up-draft for ½ min., amounting to about 2,000 cu. ft. of air. In addition to this, each lift removes in its upward passage about 2,500 cu. ft. of air. This

The natural ventilation is by a narrow stairway and about three lifts at each station. Mechanical ventilation of the tunnels is secured by a fan at Shepherds Bush Station, which draws in fresh air from the opposite end of the line—that is, Bank Station, and other stations at intermediate points. The fan is 5 ft. wide, 20 ft. in diameter, and makes 145 r.p.m. It is operated by electricity, and is rated at 300 h.p. Its capacity is 100,000 cu. ft. per min. It is operated from 1 to 4 a.m. (three hours), with the outlet doors at all intermediate stations shut, therefore it draws in fresh air from Bank Station. During the operation of the fan, the water-gage pressure in the tunnel is 4½ in., and the linear

velocity of the air in the tunnel is 500 ft. per min. The fan is also operated during each day from 11 a.m. to 5.30 p.m., or 4½ hours, all the doors of the passageways at the stations being open. This improves the air in the tunnels for about one-half the length of the line—that is, for the three miles nearest to Shepherds Bush Station—it also clears out the cars as they come to this last station.

The result of night pumping, as indicated by an anemometer placed in the tunnels at the Post Office Station (the first one west of Bank Station), shows that each week an average of 123.9 million cubic feet of fresh air entered during the night pumpings, which is equivalent to 17.7 million cubic feet per night. As the tunnels contain 6⅓ million cu. ft., they are cleared about 2¾ times each night.

The result of this night ventilation is shown by tests taken on Feb. 15, 1905, at the Marble Arch Station cross-over siding, which is about half way between Shepherds Bush and Bank Stations. At 9.30 p.m. the air was found to contain 10.3 parts of carbonic acid gas per 10,000 volumes. The fan was started at 1.37 a.m., and at 2.15 a.m. the air at the same point contained only 3.7 parts, which was the same as that in the outside air.

The amount of natural ventilation procurable is shown by some other tests made during the same night. Between 9.30 p.m. and 1 a.m. (3½ hours), the air in the tunnel had cleared slowly from 10.3 parts to 6.0 parts of carbonic acid gas per 10,000 volumes at the latter time. During these tests the temperature of the tunnels was 66½ deg. Fahr. Another test, taken on Feb. 2, 1905, with the fans not running, and when the outside air contained 4.4 parts of carbonic acid gas per 10,000 volumes, showed that the tunnel air averaged 7.07 parts of carbonic acid gas, while the air in a full car contained 10.7 parts.

The methods now adopted for ventilating the Central London Railway have been put into force since 1902, and the question of adding to this ventilating system is now being considered. The first ventilating plant on this road was at Bond Street Station, but it has not been used since the installation of the present ventilating plant at Shepherds Bush.

A long series of tests made in 1902 for the London County Council showed that the air in the cars contained a minimum of 9.60 parts of carbonic acid gas per 10,000 volumes, at a time when the outside air contained 3.30 parts, and a maximum of 14.7 parts of carbonic acid gas per 10,000 volumes, when the outside air contained 3.30 parts.

A sample of the air taken from a Central London Railway car by the writer, between Chancery Lane and Post Office Stations, on a fair day, June 27, 1905, at 1.55 p.m., temperature 76 deg. Fahr., contained 5.92 parts of carbonic acid gas per 10,000 volumes, at a time when the outside air contained 3.55 parts.

Another sample taken by the writer on July 24, 1905, from a car on the same road, between Tottenham Court Road and Oxford Circus Stations, on a still brighter day, at 1 p.m., temperature 72½ deg. Fahr., contained 7.04 parts of carbonic acid gas per 10,000 volumes, the outside air at that time containing only 1.75 parts.

Great Northern & City Railway, London.—The Great Northern & City Railway extends from Moorgate Station to Finsbury Park, a distance of 3.43 miles. It is electrically operated and lighted, and there are six stations, varying from 2,000 to 6,200 ft. apart. Drayton Park Station, which is 4,200 ft. south of the northern terminus, is all in the open for 600 ft., therefore the main tunnel on this road extends from Drayton Park to Moorgate, a distance of 2.62 miles; the longest distance between stations being from Essex Road to Old Street, 6,200 ft. This line was put into operation in 1904, and is in many respects the best one examined by the writer. It consists of two single-track tubes, each 16 ft. inside diameter, connected by five small cross-passages at each of the station platforms, in addition to some cross-overs. The station platforms are generally 420 ft. long, to accommodate a standard train of seven coaches each 50 ft. long, carrying a total of 430 passengers. The special features of this subway are its large tubes and the large stairways and passageways, as compared with other London subways. Each of these items is claimed by the officials of the road to be a direct benefit in ventilation. The line is expected to handle 27,000,000 passengers per annum. The maximum train service arranged for is a 3-min. spacing, making 3½ miles in 13½ min., including 20 sec. for each of four intermediate stops.

The area of each tube is 190 sq. ft., the area of the two tubes being 380 sq. ft. The area of the tunnel, therefore, is about 1.8 times that of the large cars of the trains therein. The approximate cubical contents from the open end at Drayton Park to the closed end at Moorgate Station is 5½ million cu. ft.

Its natural ventilation is by two stairway passages at each station, the minimum area of each passage being 57 sq. ft., or a total of 114 sq. ft., in addition to that furnished by three lifts at every station, each having a floor area of 130 sq. ft., or cubical contents of about 1,500 cu. ft.

Its artificial ventilation, applied since the line was opened, is obtained by a fan, having a diameter of about 6 ft., located at Pool street, which is 6,330 ft. from the Moorgate end of the tubes. This fan has a capacity of 1,000,000 cu. ft. of air per hour, and, as operated, forces fresh air through a heading 10 ft. in diameter into the up-tunnel—that is, toward Moorgate Station, in the direction of travel. A large part of this current travels to Moorgate Station cross-over and then into the down-tube. The present practice is to operate this fan twice each day, during the busiest periods, from about 8 to 10 a.m., and from 5 to 8 p.m., so that a volume of fresh air practically equal to the cubical contents of the entire subway is forced into it each 24 hours.

As to natural ventilation: Measurements of the currents in the stairways on the arrival and departure of trains show approximately a total of down-currents for each train per station of 20,000 cu. ft., and about the same for up-currents. The total ventilation per train for each direction, therefore, amounts to about 90,000 cu. ft. On a 5-min. spacing of trains, each filled with 430 persons, the change of air per hour amounts to 1,080,000 cu. ft. in the entire subway, or 18,000 cu. ft. per min. However, as there are constantly four trains in the tubes carrying a maximum of 1,720 people, and as each person requires 30 cu. ft. of air per min., the total requirement is more than 51,000 cu. ft. of fresh air per min., in order to keep the tunnel air of the same quality as the outside air, or about 26,000 cu. ft. per min. in order not to increase the carbonic acid gas by more than twice the quantity in the outside air. These figures show why ventilation has been found necessary during the busy hours to maintain air of the desired purity even in this excellently constructed subway.

On March 5, 1904, before ventilation was established, a test of the air in this subway was made by Dr. Critchley, with the following results: The air in the street was found to contain 4.5 parts of carbonic acid gas per 10,000 volumes, that of a car in the subway was found to contain 9.0 parts, the temperature being 61½ deg. Fahr.

On Feb. 20, 1905, Dr. Southerland found that the air on the platform in the subway at Old Street Station contained 4.48 parts of carbonic acid gas per 10,000 volumes, temperature 54 deg. Fahr., while that in a car approaching this station was found to contain 7.22 parts, the temperature being 55½ deg. Fahr.

A sample of air taken from a Great Northern & City Railway car, by the writer, between Highbury and Old Street Stations, on a very bright day, July 24, 1905, a little after noon, temperature 68 deg. Fahr., contained 2.35 parts of carbonic acid gas per 10,000 volumes, the outside air at that time containing 1.75 parts.

Rapid Transit Railway, New York City.—The subway sections of this railway are either four-tracked, of rectangular cross-section, or of two double-tracked cross-sections. The former is the one used on the busiest part of the line, below Forty-second street. The stations on this portion average about 1,500 ft. apart. The area of this four-tracked cross-section is about 650 sq. ft. The sectional area of the tunnel therefore is 1.8 times that of the four trains occupying the subway.

This subway is of steel construction, with concrete, and is built quite close to the surface of the streets. The outlets to the street at the stations consist of from two to a maximum of eight stairways, which, while large enough for the people entering the stations, are not as direct as in some of the European subways, and have not a total outlet area as large in proportion to the tunnel cross-section, or to the number of trains and people in the subway at one time.

The writer predicted in 1904 that mechanical ventilation would be found necessary to secure a positive change of air.

On Nov. 21, 1904, a sample of air was taken from a car in the Rapid Transit Subway, between Forty-second and Twenty-eighth streets, and one between Spring street and Astor Place, and these were found to contain too great a percentage of carbonic acid gas. Again, on Dec. 28, 1905, at 4 p.m., the temperature being 60 deg. Fahr., a sample of air, taken from a car of the Rapid Transit Railway, between Twenty-third street and Brooklyn Bridge stations, was found to contain 15.58 parts of carbonic acid gas per 10,000 volumes of air.

The various tests of air made by the writer in London and Paris have shown that, except in the deeper subways, the air has as high a temperature as that outside. In the Rapid Transit Subway, during the summer of 1905, a considerably higher temperature of the air was recorded. This is another reason why it will become very urgent to establish a complete system of mechanical ventilation, for the health of the employees and the comfort of the patrons, as in the case of the subway tunnels in Boston, Liverpool and London.

Subway Tunnels Generally.—Among the statements heretofore made are included records of the determination of carbonic acid gas in the London subways as well as in their cars. From these data, also from other similar tests of air reported upon by the London County Council, in subway tunnels when they were not fully ventilated, the air found in subway cars contains about 45 per cent. more carbonic acid gas than the average air found in the subway tunnels and stations. Inasmuch as the patrons and a large number of the employees of a subway tunnel line spend most of their time in the cars, the vital fact to be determined, as to the health and comfort of these individuals, is the amount of carbonic

acid gas in the cars themselves. Therefore, tests of air in subway tunnels and stations are simply somewhat indicative of the conditions that will be found in the cars. It may be anticipated that the amount of carbonic acid gas in the cars will be at least 45 per cent. more than in the subway tunnel, and in crowded cars the proportion of carbonic acid gas will be still greater.

The writer, therefore, has confined his investigations everywhere to the vital question, namely, the quantity of carbonic acid gas found in the ordinary cars of tunnels, and the tests by him were taken in cars ranging from one-fourth to one-half full. Any reports of the amount of carbonic acid gas found in subway tunnels or stations, therefore, should be increased by about 45 per cent. in order to obtain any fair idea of the conditions met by the passengers and employees themselves; so that, if a subway contains as much as 6.5 parts of carbonic acid gas per 10,000 volumes of air, there will probably be found in the cars 8.4 parts or more.

It has further been shown by detailed measurements of natural ventilating currents in the London subway tunnels, from the smallest to those of the largest section, that an insufficient quantity of air is drawn into them to ventilate all parts of them properly. While the portions having light traffic may at times be free from too large a proportion of carbonic acid gas, those parts having heavy traffic will contain an excess. The conditions of traffic in the Rapid Transit Railway of New York, for example, are such as to indicate the presence of much more carbonic acid gas in the cars while traversing the lower portions of the subway tunnel than in the remainder.

Proper ventilation is not secured unless all parts of a subway tunnel receive a sufficient quantity of fresh air to balance properly the vitiation of that in the cars by the occupants thereof, and this result cannot be secured, as has been shown, except by an efficient system of mechanical ventilation that will distribute fresh cool air everywhere in the cars, as well as in the subway tunnel and its stations.

Standard of Purity for Air.—Much has been written as to what constitutes good air and what is dangerous. The most important test is the determination of the parts of carbonic acid gas (CO_2) in a given sample per 10,000 volumes. Ordinary air varies considerably, during different kinds of weather, from about 1½ parts to more than four parts of carbonic acid gas per 10,000 volumes, but the ordinary figure is about four parts. The best authorities state that the air in any subway should not contain more than twice the amount of carbonic acid gas found in the outer air (the two being nearly always directly compared), and that, therefore, the general limit is eight parts of carbonic acid gas per 10,000 volumes. The "Factory Act" of England makes nine parts of carbonic acid gas as the maximum in rooms, etc. The report to the London County Council in 1902 places the safe limit at eight parts, as being the maximum that should exist in the air of subways; and that report states further that the number of bacteria in subway air was generally found to increase and decrease in proportion to the carbonic acid gas in the air. The writer, while investigating this subject in London, during July, 1905, learned that public opinion is very strong in demanding air in subways that shall generally not contain more than eight parts of carbonic acid gas per 10,000 volumes of air, and that periodical attacks by the press are made, substantiated by detailed reports of noted chemists, against any subway tunnel where, for a period, air is found to contain more than this quantity of carbonic acid gas. Hence, it may be stated that eight parts of carbonic acid gas per 10,000 volumes is the maximum proportion of carbonic acid gas that should be allowed in the air of cars in subway tunnels.

Freight Terminal Facilities at St. Louis.

Messrs. Robert Moore and Albert T. Perkins, Consulting Engineers, have made a report to the Municipal Bridge and Terminals Commission of St. Louis in which they give much interesting information concerning the freight facilities of that city and what is needed to make them adequate to its growing needs; and from their report we take the notes given below.

The report is not a final one. One of the principal recommendations is for a new bridge across the Mississippi river at Poplar street, two-thirds of a mile below the Eads bridge. Such a bridge would be on a line with the main east and west railroad which now gives access to the Union station; and on the east side of the river (as well as on the west side) would be sufficiently high to be connected by inclined tracks with any part of the railroad system.

The freight received and forwarded at St. Louis and East St. Louis in 1905 amounted to 40,000,000 tons, or double the amount handled in 1898. In view of the development of the southern and western states it is believed that this rapid rate of increase will continue. St. Louis and East St. Louis, though divided by a great river, should be dealt with as a single traffic and manufacturing district. The engineers recommend that grounds and franchises for all necessary enlargements of the railroad system and terminals be acquired without delay, and that all railroad facilities should be made available for all of the roads, and the establishment of individual facilities by different roads should be reduced to a minimum. The new freight houses and team tracks needed should be furnished by a combination of the railroads and operated by them rather than by an association doing terminal business for profit.

The city owns six miles of the river front, or nearly all from Grand avenue on the north to Dorcas street on the south. The United States government has established harbor lines so that permanent structures may now be extended. At North Market street, for example, the present wharf, 400 ft. wide, can be made 770 ft. wide. The necessary filling can be easily accomplished. The grade from the water up to the level of Third street is steep, making a great obstacle to the teaming of freight by wagons coming over on ferry boats. Profiles are given of these grades. The transfer of cars across the river by ferry boats is considerable, and is likely to increase. There has been some difficulty with the floating ice, but only for a very few days in a year, and with a deepened river this branch of the business can be enlarged. In the year 1905 about one-third of the freight crossing the river was carried in cars on ferry boats. One-half went over the railroad bridges and one-sixth by wagons either on the bridge or the Wiggins ferry boats.

The business of the Terminal Railroad Association is heavier than ever before and is constantly increasing. In the month of March last the number of cars interchanged was 184,000. The recent reduction in the arbitraries which are added to the freight rates from the east has increased the business at the freight houses in St. Louis so that many of them are badly crowded, causing serious delays.

The Terminal Railroad Association has team tracks at 13 places with room for 1,123 cars. It is declared that there will be need in the immediate future for twice this amount of room, and the yards which should be enlarged are specified. In this connection the report calls attention to the need of economy in the use of team tracks. One acre of land will accommodate 25 cars. Estimating the cost of this land at $200,000, with interest at 4 per cent. and taxes at the prevailing rate in St. Louis on one-half of the cost of the land, the charge on each car for land interest and taxes would be $3.81, estimating that the car occupied the track three days. In this estimate Sundays and holidays are not counted. The team track problem has been complicated by the insufficient storage room provided by consignees. Some large hotels and buildings are unable to take more than a 24 hours' supply of coal.

The cost of land being high, the use of freight houses is also expensive. House room to handle 250 tons a day will cost $500,000, on which the interest and taxes would make a charge of about 33 cents a ton. The cost of elevating freight to upper stories is from 7 cents to 11 cents a ton.

The engineers have examined freight houses in the principal eastern cities. In Pittsburg the Pennsylvania Company has seven stations, at four of which freight is received for all divisions of the road. In Philadelphia the Pennsylvania has 31 stations, at 28 of which freight is received for all divisions. In New York the Pennsylvania receives at four stations, the New York Central at eight, and each receives at four places in Brooklyn. Freight houses of two or more stories are now common. Some of those visited, with the number of stories, are: The Pennsylvania at Pittsburg, two stories; Pittsburg & Lake Erie, at Pittsburg (planned), two stories, with a driveway to both stories; Wabash, at Pittsburg, four stories, with tracks on the fourth floor and hydraulic elevators down to the street; Reading, at Philadelphia, two stories. Other houses which will have upper stories to be used exclusively for storage of inbound freight are those of the Pennsylvania at Pittsburg, four stories; Baltimore & Ohio Southwestern, Cincinnati, six stories, with electric elevators; Central of New Jersey, at Newark, six stories, with electric elevators. At Baltimore and Washington, to economize freight house space, the railroads have contracted with a teaming company to deliver goods to store doors within a certain district. The great Cupples station at St. Louis, which handles 25,000 tons of freight a month, has now a number of imitators, notably the Pittsburg Terminal, Warehouse & Transfer Company and the Bush Terminal at Brooklyn. The Cupples station was started primarily to accommodate a large number of wholesale merchants occupying a single large building, which does not seem to be the case at Pittsburg and Brooklyn, though the Bush Terminal Company owns large buildings to be rented for manufacturing purposes.

The report then goes on to recommend the consolidation of the Cupples and the Tenth street stations, which are close together, and the building of a station 1,200 ft. long and six stories high north of the Eads bridge.

For the proposed new bridge across the river a plan and elevation are shown. It is proposed to have a main span 1,600 ft. long, which is necessary not only to comply with the law, but to avoid interference with ferry traffic. The bridge should be built for four tracks, as that width is necessary for lateral stability in so large a span. The estimated cost, including right of way, is $8,000,000.

The Flaman Speed Indicator.

On the continent of Europe it is common practice to provide passenger locomotives with a speed indicator which records automatically the speed attained throughout the run. This puts a check on the driver and enables the superintendent to be sure that prescribed speed limits are not exceeded. The value of a means of preventing a driver from making up lost time by an excessive burst of speed is beyond argument. On the Eastern Railway of France, M. Flaman, chief designing engineer of the motive power department, has designed the apparatus described herewith. The accompanying figure shows clearly the appearance and general arrangement. In the upper part is a semi-circular scale on which two hands move. One hand is painted red and is movable from the outside of the case, being merely used to mark the highest allowable speed. The other hand, which in the illustration stands at 31, is connected to the mechanism and shows the speed of the locomotive. The small circular dial with divisions numbered from 1 to 10, is merely a clock face, the small hand making a revolution every 10 minutes. In the lower part of the case is seen the recording mechanism by which the speed is recorded by a moving pen on a traveling strip of paper in the usual way. It will be noticed that the recording pen is always in

The action of the mechanism by which the speed is measured is simple in principle and positive in operation. In principle it con-

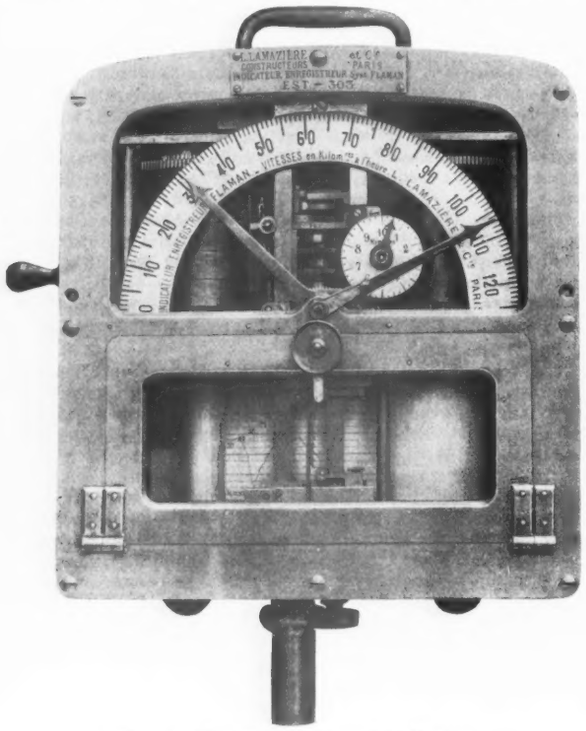

L. LAMAZIERE
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Fig. 1—The Flaman Speed Indicator.

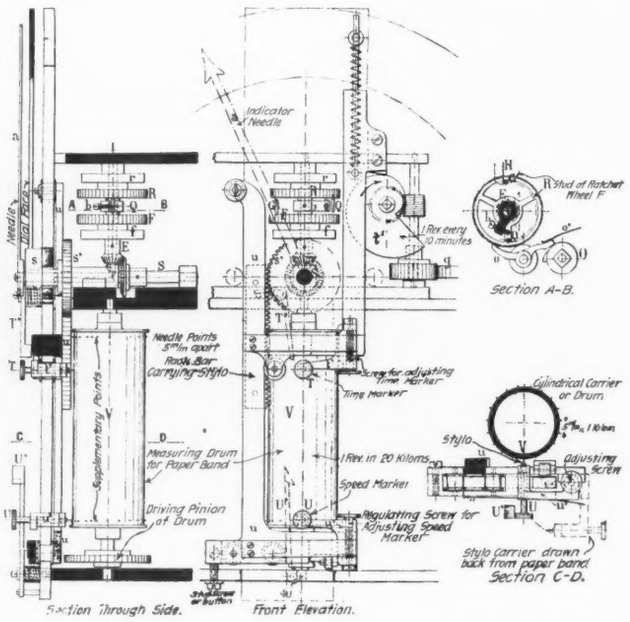
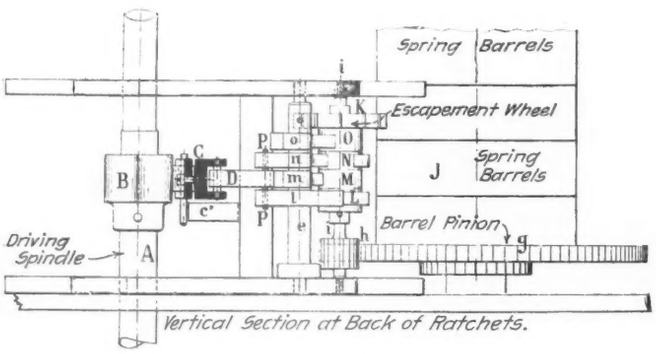
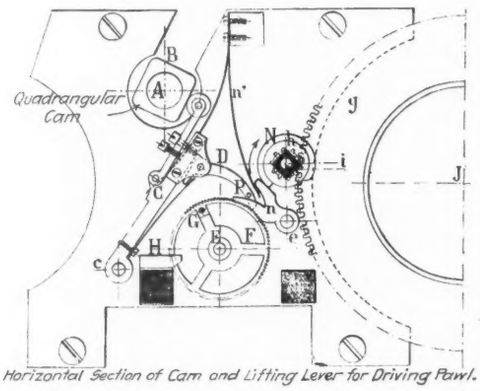
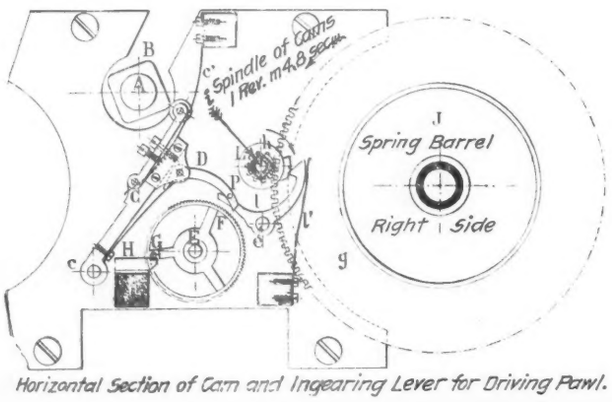


Fig. 2—General Arrangement of Flaman Tachograph.

V—Measuring drum.
T—Time marker.
F—Rachet pinion, measuring speed and carrying driving stud G.
I—Cam with archimedian spiral, turning once in ten minutes.
L—Speed marker.
u—Rack gearing.






Spindle of Coins 1 Rev. in 4, 8 secs.
Spring Barrel
Right Side
Horizontal Section of Cam and Ingearing Lever for Driving Pawl.

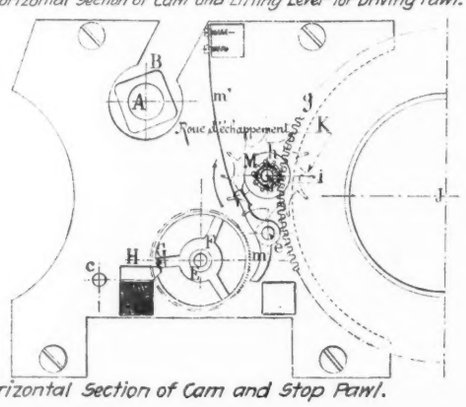


Fig. 3—Details of Flaman Tachograph.

sists in rotating a wheel connected to the driving wheels during a fixed unit of time and then measuring the distance this wheel has turned through in the fixed time. In practice it is connected to turn with the driving wheels, and a connection is provided by means of a pawl acting on a ratchet wheel, so that this ratchet wheel receives four impulses, the pawl moves through four notches, during a revolution. This ratchet wheel is driven from the locomotive driving wheels during 3.6 seconds (the one-thousandth part of an hour), and then during the next 1.2 seconds the distance through which it has turned is measured and the wheel returned to its original position, to be again connected to the driving wheels. Thus the speed of the locomotive is measured every 4.8 seconds, that is 12.5 times each minute, and the speed shown is the average speed during the preceding 3.6 seconds. As the ratchet wheel from which the speed is measured receives four impulses during each revolution of the driving wheels, the speed can be measured accurately to within a quarter revolution of the driving wheel.

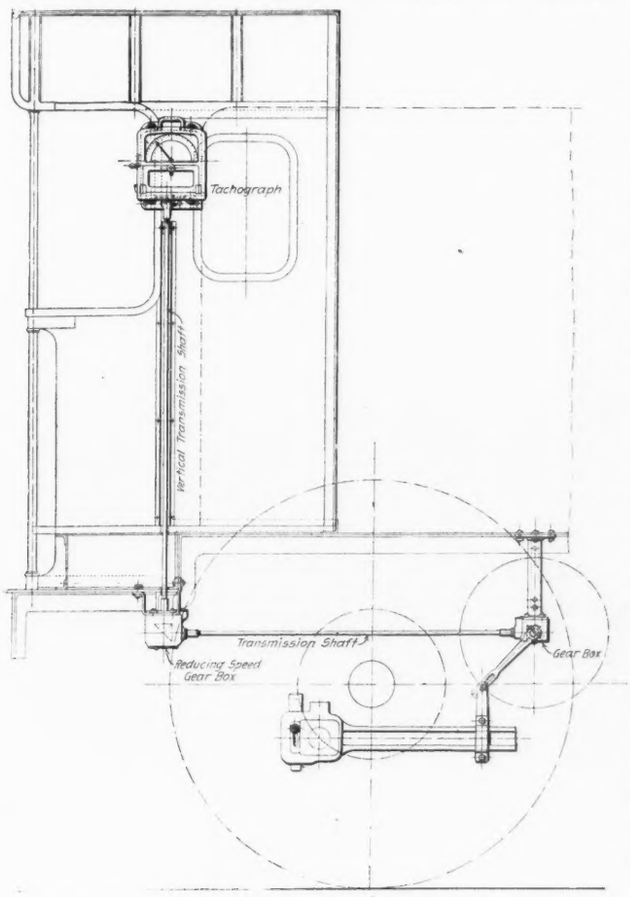


Fig. 5—Transmission Shafts, Flaman Tachograph.

The action is shown in Figs. 2 and 3. The driving shaft A (Fig. 3) carries the square cam B which turns the ratchet wheel F through the pawl D. When released the wheel F is returned by a spring until the pin G rests against the stop H. The escapement wheel K has 12 teeth and under the influence of an escapement beating fifth seconds makes a revolution in 4.8 seconds. This escapement wheel carries on its shaft the four cams L M N and O, which control the cycle of the operations which measure the speed. The cam N throws out the pawl D after it has driven the wheel F for 3.6 seconds, then the cam L holds the pawl out of connection with the wheel F for the remaining 1.2 seconds of the period and drops it back into connection at the beginning of a new period. When the pawl D is thrown out the wheel F is held by another pawl for about $\frac{3}{5}$ of a second, while the measurement of the speed is made and then this pawl is released by the cam M and the wheel F returns to its zero position to begin another cycle of movements. The measurement of the speed, that is of the angle through which the wheel F has turned, is made by the wheel R which is connected to the hand which works on the dial. When the wheel F, after turning for 3.6 seconds under the influence of the driving wheels is brought to rest as described above, the cam O releases the wheel R, which turns under the influence of a spring until the pin Q on the wheel R comes against the pin G on the wheel F. The amount of this turning, as measured by the hand on the scales, shows the average speed during the preceding period. The position of the hand on the scale is adjusted to the speed every 4.8 seconds. If the speed is increasing the wheel F will turn through an increasing angle in each period and during the end of its course will therefore carry the wheel R (and the hand) forward with it, while when the speed is decreasing the wheel R will drop back at the end of each period. The recording mechanism is shown in Fig. 2. The pen U carried by the frame U is connected with the previously described mechanism and is lifted as the speed increases. Another pen T serves to record the time and makes a vertical stroke with an instantaneous return every 10 minutes. A record is reproduced in Fig. 4.

Up to May 1, 1906, there were 359 of these speed indicators in service and 205 in course of application in France and Italy.

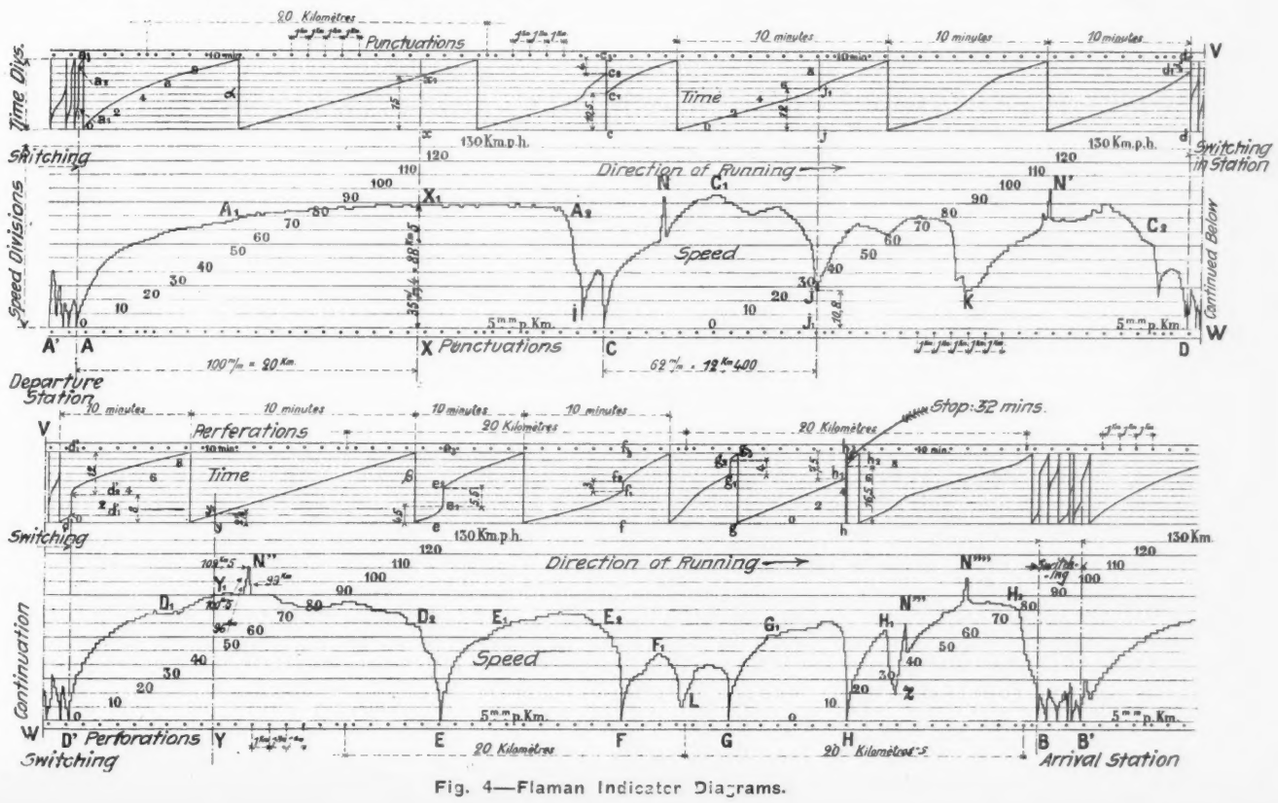


Fig. 4—Flaman Indicator Diagrams.

A New Sullivan Air Compressor.

The accompanying engravings illustrate a new type of Sullivan air compressor, especially designed to meet the requirements of industrial service, of railroad and machine shops, foundries and large buildings, as well as the general purposes of contracting, mining and quarrying work. It is a duplex pattern and is built in several combinations of steam and air cylinders, and also for belt and power drive. The dominant feature of the different types is the box frame, with housing, which forms a tight enclosure about the crank discs, main bearings, eccentrics, connecting rods and crossheads. This housing excludes dust and dirt and permits the use of a system of self-lubrication of the principal working parts. As shown in the sectional view, an oil well is provided in each frame, in which the lower edges of the crank discs are immersed The oil clinging to the discs is removed by scrapers in contact with their upper edges, and thence conveyed by means of a storage chamber and suitable pipes to the main journals, crank pins, eccentrics and crosshead guides, being finally returned to the well by gravity to be used again. The machines require the minimum of attention and care, and it is necessary to add oil to the wells only at long intervals.

These compressors are very compactly and substantially built. All sizes except those of largest capacity are mounted on a heavy sub-base, in which the intercooler and steam reheater (on cross-compound machines) are situated. The frames are of the heavy duty type or tangye pattern, with long bearings on the base, securing rigidity and maintenance of correct alinement of working parts. The steam valve gear is controlled by a Meyer adjustable cut-off, the throttle being regulated by a sensitive steam and air governor.

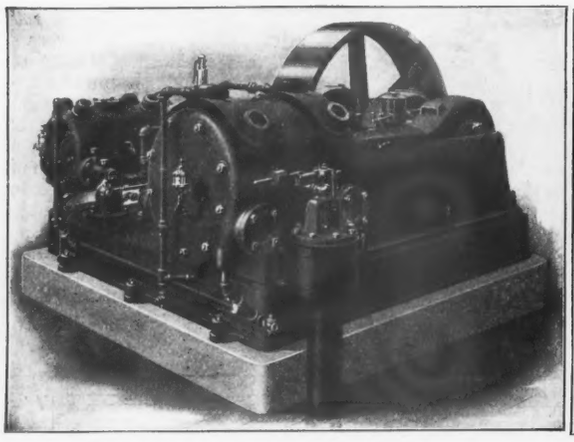
The air cylinders are not cored out, but instead separate liners are forced into the casting, thus precluding shrinkage strains. The space between the liner and the cylinder forms the water jacket, and outside of this again is the air inlet passage. Incoming air is thus admitted to the cylinder without contact with heated walls. The air cylinder heads are also water jacketed, and in two-stage compressors an efficient intercooler is provided.

The inlet valves on all air cylinders are of the semi-rotary or Corliss type and are moved by steel valve stems connected by adjustable connecting rods to independent eccentrics on the engine shaft. The moving parts start from and arrive at the ends of their travel with a slow and easy motion, but at the points of opening and closing of the valves these parts attain their greatest speed. It is thus possible for the valves to remain open during the entire stroke, allowing the cylinder to fill with air at barometric pressure, and trapping it instantly before the piston begins its return.

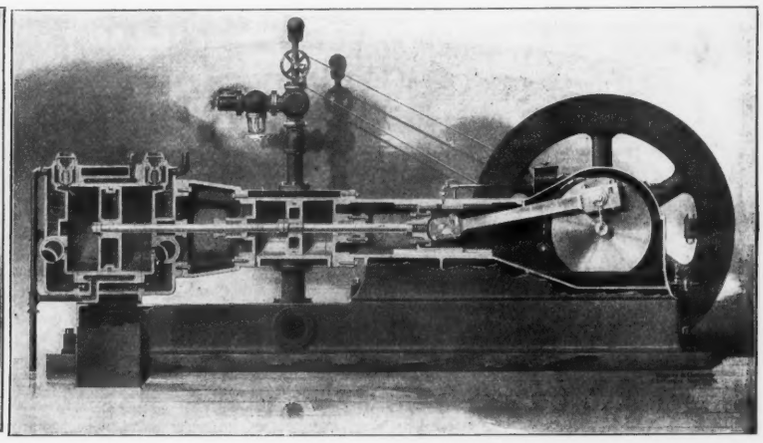
The valves themselves are made of close-grained semi-steel, of large diameter, fitted with accuracy. Provision is made to permit a thin film of air to get behind the closed valve, pressing the cutting edges to the seat and making the valve tight against leakage. The valve stems have T-shaped heads on their inner ends, carefully planed and fitted to the slots in the ends of the valves. The attachment is such that the valves are free to follow up wear automatically without hindrance from the stems. These valves may be removed through the back bonnets without disturbing the setting of the valve gear. This valve gear, it is claimed, is simple, strong and durable, is positive and reliable in action, and insures high volumetric efficiency.

The discharge valves are placed radially on top of the cylinder head castings. They are set with removable seats in shallow ports or pockets, as shown in the sectional view, at a sufficient distance from the ends of the cylinder for the piston to travel completely past the openings to these pockets, at each end of the stroke, thereby minimizing the clearance. These valves are of the poppet type, interally guided on cast iron plugs and held to their seats by light steel springs. They are seated in bronze cages, readily removable by unscrewing the valve plug. As seen in the sectional view, they are completely surrounded by water jackets to reduce the temperature of the air at its terminal pressure.

These compressors are built in capacities ranging from 100 to 2,600 cu. ft. of free air per minute. The Sullivan Machinery Co., Chicago, the maker, has built an addition to its works at Claremont, N. H., to make these compressors.



Sullivan Air Compressor—Two-Stage Belt-Driven Type.



Sectional View of Sullivan Air Compressor.

Publication of Rate Changes and Other Things.

The Interstate Commerce Commission has issued the following rulings:

Nothing but money can be lawfully received or accepted in payment for transportation subject to the act, whether of passengers or property, or for any service in connection therewith, it being the opinion of the Commission that the prohibition against charging or collecting a greater or less or different compensation than the established rates in effect at the time precludes the acceptance of services, property, or other payment in lieu of the amount of money specified in the published schedules.

Where two or more connecting carriers establish a joint rate which is less or greater than the sum of their local rates, such joint rate is a change of rates and requires a notice of thirty days. In such case the joint rate when duly established and in force becomes the only lawful rate for through transportation.

On new lines of road, including branches and extensions of existing roads, individual rates may be established in the first instance, and also joint rates to and from points on such new lines, without notice, on posting a tariff of such rates and filing the same with the Commission.

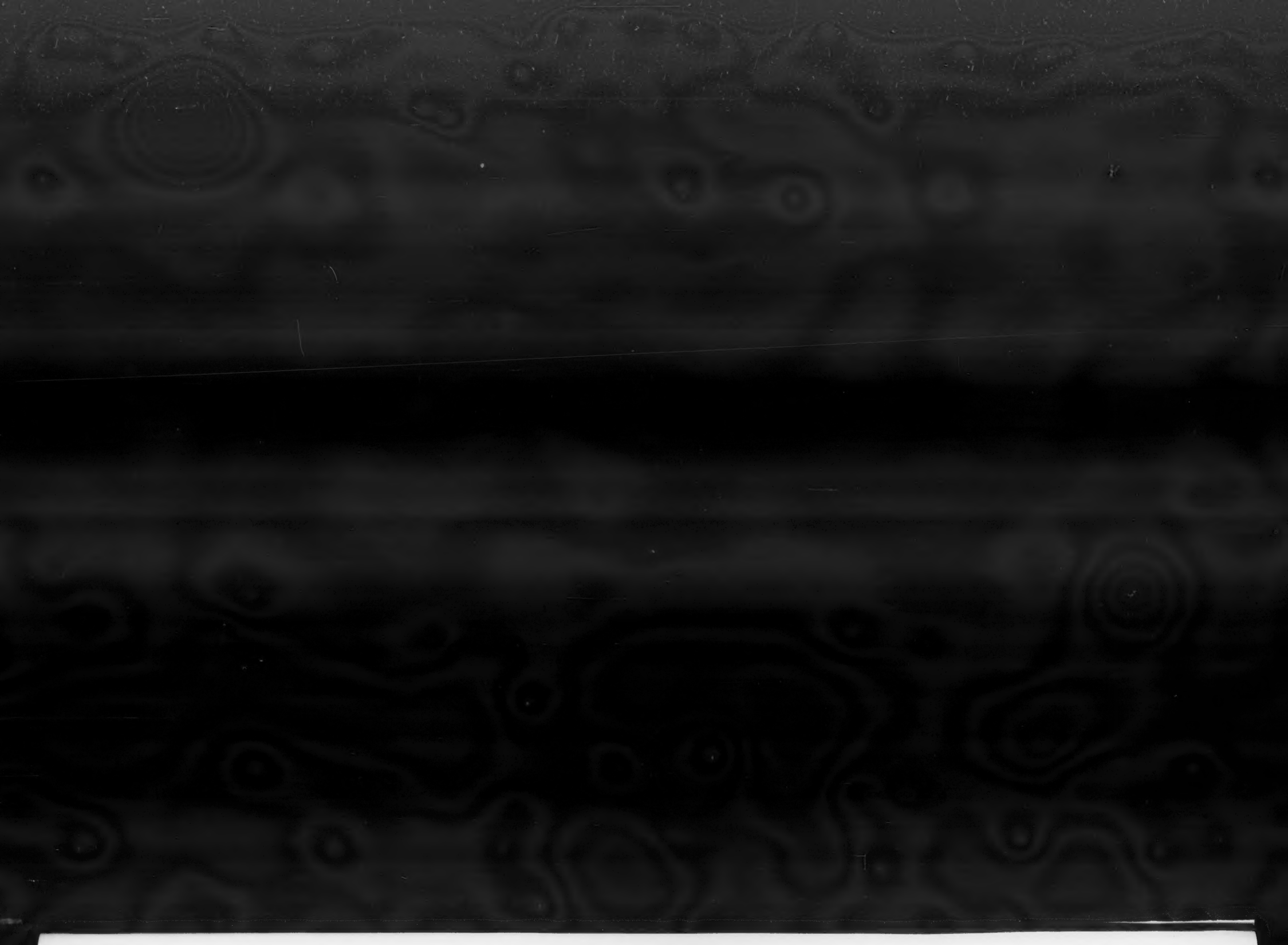
It is the opinion of the Commission that the provisions of the amended sixth section in respect of the publishing, filing and posting of tariffs apply to the mileage, excursion and commutation rates authorized by the twenty-second section. Such a rate when first established or offered is held to be a change of rates which requires a notice of thirty days. No reason appears why this notice should not be given in the case of mileage rates, commutation rates, round trip rates or other reduced rates which, like ordinary passenger rates, are established for an indefinite period, and appear to be a matter of permanent policy. Strictly excursion rates, however, covering a named and limited period, are of a different character in this regard, and may properly be established on much shorter notice.

To avoid the necessity for special application in cases of this kind, the Commission has made a general order fixing the following named time of notice of round trip excursion rates, and carriers may govern themselves accordingly:

Rates for an excursion limited to a designated period of not more than three days may be established without further notice upon posting a tariff one day in advance in two public and conspicuous places in the waiting room of each station where tickets for such excursion are sold and mailing a copy thereof to the Commission.

Rates for an excursion limited to a designated period of more than three days and not more than thirty days may be established upon a notice of three days in place of the thirty days' notice otherwise required by the amended sixth section.

Rates for an excursion limited to a designated period exceeding thirty days will require the statutory notice unless shorter notice is allowed in special cases by the Commission.



GENERAL NEWS SECTION

NOTES.

The Delaware, Lackawanna & Western has, at Whitehall, N. J., and Alden, N. Y., 50,000 young yellow locust trees which are to be grown for ties.

A press despatch from Chicago says that the Burlington road has ordered that enginemen who wear spectacles be not employed on passenger trains, or on freight trains running to or from busy terminals.

The Pennsylvania Railroad, responding to the circular of the Interstate Commerce Commission, has notified that body that of its 133,000 freight cars owned east of Pittsburg and Erie, 98 per cent. are equipped with air brakes.

Press despatches from San Francisco report that the freight blockade at that city is nearly lifted, lumber and hay being the only commodities on which embargoes are still in force. The rate of demurrage is $5 per car per day.

On the Wheeling & Lake Erie at Toledo last Friday night a hand car, loaded with trackmen, ran off an open draw over the Maumee river bridge, and every one on the car was drowned. The number of men on the car is said to have been 12.

The Long Island Railroad announces that after this month season tickets to and from New York will be sold at a uniform rate monthly, instead of charging a higher rate at the beginning of each year, to be equalized by a reduction in the last half of the year.

The State Railroad Commissioners of Arkansas, on complaint of competitors of the Standard Oil Co., have ordered large reductions—in some cases 50 per cent.—in freight rates on oil, and have ruled that oil shipments must be received on three days in each week.

The Boston & Albany seems to have decided to reduce its passenger fares from the present basis of 2¼ cents a mile to two cents a mile; though the only authoritative announcement of the fact is that which comes through a letter written to the Interstate Commerce Commission.

The Interstate Commerce Commission, on application of the Boston & Maine, has authorized the adoption on short notice of a reduced rate on southern lumber from Boston to Rockland, Me., ($1 a ton) provided the same rate is put in force to all intermediate stations where there is water competition.

The Massachusetts Railroad Commission, as announced on advertising page 22, is to give a public hearing in Boston, Oct. 2, on the question of block signals and fire extinguishers, in pursuance of a law passed by the last legislature. Under this law the Commission has power to order the establishment of block signals.

The governor of Oregon has called upon all of the railroads in the state to file detailed reports of the value of their property, market values of stock, etc., in accordance with the law of 1885. This law has remained unenforced because of doubt as to its validity, the claim being made that it was repealed by an act passed in 1887.

According to a press despatch from Omaha, "Strike-Breaker" Farley took to San Francisco, on the occasion of the street car strike in that city, early in this month, 1,200 men. After the strike was settled, 700 of these men remained in California, and on September 13th 500 passed through Omaha on their way back to New York.

Large fans for cooling the air by blowing it over nests of water pipes have been in use at the Brooklyn bridge station of the New York city subway for two or three weeks, and the temperature on hot days has been reduced, it is estimated, about 5 deg., say from 83 F. to 78 F. The improved freshness of the air is as grateful to the passengers as is the lowering of the temperature.

The State Railroad Commission of Washington has been enjoined by the United States Court from enforcing its order, issued some weeks ago, requiring reductions in wheat rates from the eastern part of the state to the coast, over two or more railroads. The injunction is granted on the application of the railroads, who claim that the legislature has no power to delegate the making of rates to any other body.

The Illinois Central, beginning Oct. 2, will run a special farmers' instruction train in Mississippi and Louisiana, following the fashion of the lecture trains which have been run in northern states by this and other roads during the past few years. Lectures are to be delivered at 97 places. Professors from the state agricultural colleges and experts from agricultural and immigration organizations will take part.

Lieut.-Gen. Corbin, in a report to the War Department, describes at length the hardships which have been imposed on officers of the army by the action of Congress in revising the interstate commerce law so as to put an end to the practice of railroads giving to officers and men of the army half rates for themselves and their families. The general says that this will make foreign service very distasteful to the officers.

Judge Hough, in the United States Circuit Court at New York City, has fixed Oct. 10 as the day for the trial of the cases against the New York Central and certain shippers for giving illegal reductions in rates on sugar. In the cases of Messrs. Guilford and Pomeroy, who were indicted along with the road, the charges of conspiracy have been dismissed, so that these two men are now free from liability to punishment by imprisonment, although still liable to be fined.

The Lehigh Valley has taken action similar to that of the Erie and the Lackawanna in the reduction of rates, as follows: "Effective Nov. 1, or as soon thereafter as possible, the maximum rate on the Lehigh Valley system will be on the basis of 2½ cents a mile. This will not change passenger rates now based on a charge of less than 2½ cents a mile. Interchangeable mileage books will be sold at $25, instead of $30, with a rebate of $5 on each 1,000-mile book, instead of $10, as at present."

The Illinois Central is to establish at Chicago a laundry for cleaning linen used on its cars, the amount of which monthly is given as follows: Ninety thousand napkins, 30,000 tablecloths, 10,000 aprons, 6,000 jackets, 50,000 towels and 2,000 caps, table felts, etc. This covers laundering for 32 dining cars, 11 officers' cars, one pay car and the five eating houses at Chicago, Champaign, Decatur, Louisville and Memphis. The Illinois Central uses about $8,000 worth of new linen each year.

A press despatch from San Francisco says that the Southern Pacific and the Western Pacific have agreed to leave to a board of arbitration the amounts to be paid by the W. P. for lands owned by the S. P., between Oakland and Oroville, which are to be taken for the new railroad which is being built by the W. P. It is also said that the engineers of the W. P. are trying to so plan their work that the line, from Salt Lake through to San Francisco, can be open for business on the first of January, 1909. Other press despatches say that the contractors want 5,000 more men and are having much difficulty in finding them.

The New York City Railway and also its controlled line, the Union Railway, operating the surface street cars in New York City and Westchester County, have made important advances in wages. In Manhattan, motor men the first year are advanced from $2.10 to $2.25; conductors from $2.00 to $2.15. Wages are advanced yearly until the fifth year, when motormen will henceforth get $2.60 instead of $2.50 and conductors $2.45 instead of $2.35. On the Union Railway, which operates in the Borough of the Bronx and in Westchester County, the rates are somewhat lower. The increase had not been specifically asked for by the men, and appears to have been due to increasing difficulty in securing good men. The new rates are 10 or 15 per cent. higher than those of other street surface railroads in the vicinity of New York.

Representatives of coastwise steamship lines have notified the Interstate Commerce Commission that they wish to join in through rates made by the railroads for rail and ocean shipments, but that in doing so they must give notice that they do not assent to the jurisdiction of the commission. This is deemed necessary to preserve their rights under former laws in regard to liabilities for losses at sea. At the same time, the vessel men declare their willingness to promote the general purposes of the new rate law.

Representative Hepburn says that the members of the Interstate Commerce Commission will draft a bill, to be presented at the next session of Congress, modifying such features of the new rate law as may prove to be unsatisfactory in administration.

A member of the Interstate Commerce Commission says that since the first of September railroads all over the country have been filing numerous freight tariffs showing reduced rates.

Detroit Tunnel.

The contract for the Detroit river tunnel for the Michigan Central has been let to the Butler Brothers Hoff Co., of New York. Design "A" modified will be used. This design may be described as a method by which the previous material underlying the river is replaced by an imperfectly water-tight mass of concrete sunk from scows on the surface of the water, through which, without

the use of shields, the inner tubes or tunnels proper may be constructed to secure water-tightness and continuity of strength, the whole work being done without the use of high air pressure or cofferdams. The contract calls for the completion of the work by June 1, 1909. See *Railroad Gazette*, Feb. 16, p. 149, also Feb. 23, p. 184.)

British Terminal of the C. P. R.

A press despatch says that the Canadian Pacific Railway is considering making the terminal of its Atlantic fleet in England at Fishguard instead of Liverpool. The change would depend on the Great Western Railway agreeing to build a direct line from Fishguard to London.

Western Union Bond Issue.

A special meeting of the stockholders of the Western Union Telegraph Company has been called for October 10 to authorize an issue of $25,000,000 4 per cent. bonds. It is expected that $10,000,000 of this amount will be issued soon, the stockholders being given an opportunity to subscribe for them on terms to be announced later. Since 1881, the Western Union has spent $39,074,066 in extending its lines and buying property.

Disastrous Collision near Sudbury, Ont.

In a butting collision on the Canadian Pacific near Sudbury, Ontario, Sept. 12, between a westbound train carrying harvesters and an eastbound express train, 12 persons were killed and three fatally injured. A statement by an officer of the road says that the engineman of the eastbound train claims that the air-brakes did not hold; and that this assertion is correct. An angle cock in the air-brake pipe of a car in the middle of the train had been shut, cutting off from the control of the engineman the brakes of the heaviest cars in the train.

Electric Traction to Atlantic City.

The electric equipment (third rail) of the West Jersey & Sea Shore between Camden and Atlantic City, by way of Newfield, has been so far completed that electric trains were put in service on Wednesday of this week. Through express trains are run hourly each day, each way, from 7 a. m. until 11 p. m., and there are three local trains each way between Atlantic City and Newfield. The distance from Camden to Atlantic City by this line is about 64 miles, and the time of the express trains is one hour 30 minutes. The one-way fare through is $1, and the round trip is $1.70. These rates are about 20 per cent. lower than those prevailing heretofore.

Publication of Tariffs on Cotton for Export.

The Interstate Commerce Commission, after hearing the petition of the Southern Railway and other carriers east of the Mississippi River and south of the Ohio and Potomac rivers, for permission to equalize export rates on cotton, cottonseed and its products and lumber, and thereby make changes in their export rates on those commodities without the 30 days' notice required by law, and having heard numerous shippers, and the Commission being of the opinion that carriers may legally issue through bills of lading from the interior point of shipment to a foreign destination which specify the inland rate to the port of export and the ocean rate from the port of export, even though no joint through rate is published, has ordered that no published rates on cotton shall be advanced, except upon 30 days' notice; and that until March 1, 1907, carriers may reduce their published export rates on cotton to the various ports of export upon three days' notice. Until November 1, 1906, carriers may continue to equalize export cotton rates through the various ports by applying the lowest combination through all the ports, thereby making said rates without publication and filing, provided that they post notices of the rates as soon as they are made and mail copies to the Commission, said notices to specify the time during which the rate will continue in effect.

As to cottonseed and its products and lumber the petition is denied.

Large Contracts for Signals.

The General Railway Signal Company of Buffalo and Rochester had on its books September 1st unfilled orders to the amount of $2,500,000, which includes large orders from the Nankai Railway of Japan, the New York Central, the New York, New Haven & Hartford, the Philadelphia & Western, the Illinois Central and the Great Northern. According to the *Rochester Democrat and Chronicle*, from which we take this statement, some of these orders are as follows:

New York Central, eight mechanical interlocking plants in addition to the all-electric signals at New York, and 17 mechanical plants for the Big Four; New York, New Haven & Hartford, block signals for the electric zone, Woodlawn to Stamford, 19 miles of four-track; Illinois Central, automatic block signals, Pullman to Kankakee; Great Northern, automatic block signals on 50 miles of double track near Superior, Wis. The Japanese contract is for the Young system of automatic signals for electric lines.

The General Railway Signal Co. now employs 1,800 men, and the shops at both Buffalo and Rochester are running day and night. The Taylor all-electric interlocking apparatus thus far made and installed by this company, with apparatus now in course of construction, aggregated, up to the first of August, 12,500 levers, a number which an officer of the company declares is three times as large as the aggregate of all the other power interlocking in the world.

Disastrous Train Wreck in Oklahoma.

On the morning of Tuesday last northbound passenger train No. 12, of the Chicago, Rock Island & Pacific, broke through the bridge spanning Cimarron river, near Dover, Okla., and, with the exception of two sleeping cars at the rear, was entirely wrecked. The engine was submerged and the smoking car floated some little distance downstream. At this writing, the number of victims is not known, but the estimate is eight passengers dead and 20 injured, with 10 or more missing, all of whom, probably, are drowned. Several men floated downstream on wreckage, one going in safety nine miles. The river had been swelled by a flood and it is said that the bridge had been forced out of position by floating driftwood. The engineman and fireman saw the danger in season to jump off and save themselves, and the engineman had applied the brakes. The river is said to be 1,500 ft. wide at this point. Heavy rains did great damage in Kansas and Oklahoma last week.

Manufacturing and Business.

The plant of the Morse Chain Co. has been removed from Trumansburg, N. Y., to Ithaca.

G. H. Forsyth, Director and Assistant Manager of the Boston Belting Co., died on Sept. 6th at Brookline, Mass.

The B. F. Sturtevant Co., of Boston, is to install its heating system in the new roundhouse of the Southern Railway at Asheville, N. C.

Th Buffalo Brake Beam Co., New York, maker of the Vanderbilt brake-beams, has opened a western sales office at the Lincoln Trust Building, St. Louis, Mo.

A. D. McAdam, heretofore Local Auditor at Detroit, Mich., of the American Car & Foundry Co., has been appointed Manager of Sales of the Michigan Malleable Iron Co.

The shipments made during the month of August by the Chicago Pneumatic Tool Co. showed an increase of 15 per cent. over all previous monthly records. The company has opened an office at Memphis, Tenn., in charge of J. F. Small.

Thomas B. Arnold, until recently with the Railway Steel Spring Co., has been appointed Southwestern Representative of the Detroit Seamless Steel Tubes Co., Detroit, Mich., maker of the "Detroit" locomotive flue. His headquarters will be in St. Louis.

The McConway & Torley Company, of Pittsburg, has issued a new edition of its Car Interchange Manual, covering all the decisions of the Arbitration Committee of the Master Car Builders' Association from November, 1888, to May, 1906, and will be glad to mail a copy free on request to any car man. The "Ready Reference Tables" for the use of men in the car department, and a new edition of the Catechism on the M. C. B. Rules also will be mailed free.

The United States Civil Service Commission announces examinations October 17 for the following vacancies in the Philippine service: Master builder, $2,750 per annum; bridge engineer, $2,250 per annum; principal assistant chief engineer, Department of Sewer and Waterworks Construction, Manila, $4,000 per annum; assistant engineer, $1,800 per annum; second assistant engineer, $1,800 per annum. Age limit, 18 to 40 years on the date of the examination.

Richard S. Buck, member of the Am. Soc. C. E., has become a member of the firm of Sanderson & Porter, engineers and contractors, with offices in New York. This contracting firm does civil, mechanical and electrical engineering and construction, and has been in existence for more than ten years. It has now in hand work including the general design and construction of two hydroelectric plants on the Pacific coast, comprising about 50,000 horsepower of equipment; the power house equipment and transmission system of the McCall Ferry Power Company, on the Susquehanna river; extensive additions to the New Orleans Street Railway & Lighting systems, and to those of the Mahoning & Shenango Railway & Light Company of Ohio and Pennsylvania. Mr. Buck, the new member, should add much to the strength of its civil engineering staff. He was Engineer in charge of the difficult construction of the two arch bridges over the Niagara river, designed by Mr. Lefferts L. Buck, to whom, by the way, Richard S. Buck is not related. He has also been Chief Engineer of the Dominion Bridge Co. of Montreal. He has been for a number of years Consulting Engineer of the New York City Bridge Department, and is at present engaged on the Manhattan and Blackwell's Island bridges. He will for the present retain this position. The Sanderson & Porter firm now consists of Messrs. Edwin N. Sanderson, H. Hobart Porter, Francis Blossom, Richard Talbot and Richard S. Buck.

Iron and Steel.

The Mexican Central is in the market for about six bridges.

Shipments of rails are now being made of about 300,000 tons a month.

The Atlantic Coast Line is in the market for 25,000 tons of heavy rails, and the South & Western for 27,000 tons.

The Erie has increased its inquiry for rails from 15,000 to 40,000 tons. Inquiries for rails now aggregate nearly 200,000 tons, a large percentage of which will be ordered this month.

The Minneapolis, St. Paul & Sault Ste. Marie Railroad has given an additional order for 16,000 tons of standard rails, and the Milwaukee Electric Company 4,000 tons additional for 1907 delivery.

Orders have been given by the Harriman Lines for structural steel, including 20,000 tons of bridge material. The Pennsylvania Lines West have given orders for track elevation requiring 1,500 tons of steel, and the Central of New Jersey for a girder bridge requiring 1,000 tons.

The Pennsylvania Steel Co. has an order for 4,000 tons of bridge work for the Chicago, Milwaukee & St. Paul, and a contract for another Scherzer bridge for the New York, New Haven & Hartford. The McClintic-Marshall Construction has a contract for 1,800 tons of viaduct work for the Pittsburg, New Castle & Butler Electric Traction Co.

The Milwaukee Northern has let a contract for 2,100 tons of standard rails for 1907 shipment; the Seattle Electric Co. for 1,800 tons; the Fairmont & Mannington for 1,500 tons; the Missouri, Kansas & Texas for an additional lot of 18,000 tons; the Indianapolis, Huntington, Columbia City & Northwestern for 1,500 tons; the Los Angeles Railway for 2,500 tons; the Chicago Terminal Transfer Co. for 5,000 tons, and the Missouri & North Arkansas for 6,000 tons.

Reports from Detroit state that under the direction of Joseph H. Berry plans are being made to organize a new blast furnace company, with initial capitalization of $1,000,000 to $2,000,000, to put up works on the river front at Grosse Pointe, near the eastern terminus of the freight belt railroad, known as the Detroit Terminal Railroad, controlled by Mr. Berry and now under construction. This will be the third big iron furnace enterprise in Detroit. The first is the Detroit Iron & Steel Co., with capital of $1,500,000, and the second will be the Ford blast furnace, to be built by the Michigan Alkali Co. at Wyandotte. These three plants will represent an aggregate investment of $5,000,000.

MEETINGS AND ANNOUNCEMENTS.

(For dates of conventions and regular meetings of railroad conventions and engineering societies, see advertising page 24.)

The Franklin Institute.

At a stated meeting of the Institute September 19th, the programme included a paper on "Relation of the Government to Our Water Ways," by Prof. Lewis M. Haupt.

American Society of Civil Engineers.

At the meeting of this society September 19th, the programme included a paper on "Street Traffic in New York, 1885 and 1904," by C. Richardson. This paper was printed in the *Proceedings* for May, 1906. There was also one on "Ventilation of Tunnels" by C. S. Churchill. This paper was printed in the *Proceedings* for August, 1906, and is reprinted in another column of this issue.

Railway Signal Association.

This association held its regular September meeting at Chicago, on the 11th, Vice-President J. A. Peabody (C. & N. W.), in the chair. The attendance was very small. The principal discussion announced for the meeting was the revision of the Standard Specifications for Mechanical Interlocking Plants, but no advance copies of the revised specifications had been printed for distribution among the members, and no discussion was attempted. The revision as made by the committee will be printed and distributed among the members for study and comparison with the old specifications, preparatory to an intelligent discussion at the annual meeting in October.

The other subject given in the notice, identification of insulated wires and cables, was briefly discussed, and the suggestion that manufacturers use distinctive braid covering, such as different designs of colored threads, was approved.

ELECTIONS AND APPOINTMENTS.

Executive, Financial and Legal Officers.

Baltimore & Ohio.—R. B. Keyser, of Baltimore, has been elected a Director, succeeding Jacob H. Schiff, resigned. J. B. Thayer, Fourth Vice-President of the Pennsylvania, has resigned as a Director of the B. & O.

Cleveland, Akron & Columbus.—S. C. Scott, Assistant to the Fourth Vice-President of the Pennsylvania, has been elected also Vice-President of the C., A. & C., with office at Pittsburg, Pa., succeeding J. F. Miller, retired on pension.

Louisville, Henderson & St. Louis.—Otto Marx and W. M. Bullitt have been elected Directors, representing the minority interests. The Louisville & Nashville, which controls the road, has elected the other seven directors.

Pennsylvania.—See Baltimore & Ohio.

Operating Officers.

Central New England.—G. H. Staehle has been appointed Car Accountant, with office at Hartford, Conn., succeeding D. A. Broughel, resigned to go to another company.

Chicago, Rock Island & Pacific.—W. S. Tinsman, General Superintendent of the Choctaw district, has been appointed General Superintendent of the Southwestern district, with office at Topeka, Kan., succeeding F. T. Dolan, who has been granted an indefinite leave of absence on account of ill health. H. M. Hallock, Superintendent at Oklahoma City, Okla., succeeds Mr. Tinsman, with office at Little Rock, Ark. T. H. Beacom, Superintendent at Herrington, Kan., succeeds Mr. Hallock. G. W. Rourke, Superintendent of Terminals at Kansas City, Mo., succeeds Mr. Beacom. H. R. Saunders succeeds Mr. Rourke.

Detroit, Toledo & Ironton.—R. K. Smith, General Manager, and W. C. Hurst, Superintendent, have resigned and both offices have been abolished.

Hocking Valley.—W. F. Elrod, trainmaster of the Zanesville & Western, has been appointed Superintendent of Terminals of the Hocking Valley and of the Toledo & Ohio Central, at Toledo, Ohio.

Toledo & Ohio Central.—T. M. Connors, trainmaster of the Hocking Valley at Columbus, Ohio, has been appointed to the new office of Assistant Superintendent of the Toledo & Ohio Central, with office at Bucyrus, Ohio. See Hocking Valley.

Traffic Officers.

Galveston, Harrisburg & San Antonio.—C. K. Dunlap, General Freight Agent, has been appointed Freight Traffic Manager, succeeding H. A. Jones, promoted.

Engineering and Rolling Stock Officers.

Baltimore & Ohio.—D. Gallaudet has been appointed Master Mechanic at Garrett, Ind., succeeding J. E. Davis, resigned.

Cincinnati, New Orleans & Texas Pacific.—Prof. Paul Anderson, formerly occupying a chair at the Kentucky State University, has been appointed Superintendent of Tests of this road, with office at Lexington, Ky.

Cleveland, Cincinnati, Chicago & St. Louis.—W. M. Vandersluis has been appointed Signal Engineer, with office at Cincinnati, Ohio, succeeding G. H. Macdonough, resigned.

Great Northern.—See Texas & Pacific.

Northern Pacific.—David Van Alstyne, Mechanical Superintendent, has resigned to become General Superintendent of the Dunkirk works of the American Locomotive Company. W. Moir, General Master Mechanic at Tacoma, Wash., succeeds Mr. Van Alstyne, with office at St. Paul, Minn. Effective Oct. 1st.

Pennsylvania Lines West.—W. C. A. Henry, Assistant Superintendent of Motive Power at Columbus, Ohio, has been appointed Superintendent of Motive Power of the Southwest system, with office at the same place, succeeding M. Dunn, deceased. The office of Assistant Superintendent of Motive Power of this system has been abolished.

M. S. Hodgin, Assistant Engineer of the Northwest System at Chicago, Ill., has been appointed Assistant Engineer at Pittsburg, Pa., of the Southwest system, succeeding F. N. Crowell, promoted. W. A. Hawley, Assistant Engineer at Richmond, Ind., succeeds Mr. Hodgin, and J. K. Sherman succeeds Mr. Hawley. H. W. Brown has been appointed Assistant Engineer of the Cleveland & Marietta, which is operated as a division of the Pennsylvania Lines West.

P. T. Dunn, General Foreman at Cincinnati, Ohio, has been appointed Master Mechanic of the Northwest system at Chicago, succeeding N. M. Loney, resigned.

Texas & Pacific.—Cassius Banks, heretofore Engineer of Tests on the Great Northern, has been appointed Mechanical Engineer of the Texas & Pacific, with office at Marshall, Texas.

Purchasing Agents.

Temiskaming & Northern Ontario.—V. T. Bartram, chief clerk in the Purchasing Department of the Canadian Pacific, has been appointed Purchasing Agent of the Temiskaming & Northern Ontario, with office at North Bay, Ont.

LOCOMOTIVE BUILDING.

The New York Central Lines, it is reported, are to be in the market soon for 400 locomotives.

The Yuet-Han Railroad is in the market for locomotives. The order will be placed through Shewan, Tomes & Co., of New York.

The Davenport Locomotive Works, Davenport, Iowa, report recent orders as follows: Cerro Depasco Mining Co., South America, two locomotives; Raymond Valdez, San Juan, Porto Rico, one; Buena Vista Plantation Co., Mexico, two; the Laguna Company, Yucatan, one; Central Soledad, Cuba, one; Manitoba Gypsum Co., Manitoba, one.

The International & Great Northern has ordered 10 simple 10-wheel (4-6-0) locomotives from the Baldwin Locomotive Works. The specifications are as follows:

General Dimensions.

Type of locomotive	Ten-wheel
Weight { Total	85 tons.
Weight { On drivers	65 "
Diameter of drivers	62 in.
Cylinders	20 in. x 28 in.
Boiler { Type	Radial stay, extended wagon-top
Boiler { Working steam pressure	200 lbs.
Boiler { Number of tubes	314
Boiler { Material of tubes	Gould Special Iron
Boiler { Diameter of tubes	2 in.
Boiler { Length of tubes	13 ft. 6 in.
Firebox { Length	120 in.
Firebox { Width	41 in.
Firebox { Material	Otis steel
Heating surface, total	2,397 sq. ft.
Tank capacity	6,000 gals.
Coal capacity	13 tons

Special Equipment.

Air brakes	Westinghouse
Boiler lagging	Franklin
Brake-beams	National
Brake-shoes	Am. Brake-Shoe & Fdry. Co.
Couplers	Tower
Headlights	Pyle-National
Injectors	Ohio
Piston rod packing	Jerome
Valve rod packing	Jerome
Safety valves	Ashton
Sanding devices	Waters
Sight-feed lubricators	Chicago
Springs	Railway Steel Spring Co.
Steam gages	Crosby

The Harriman Lines have ordered from the Baldwin Locomotive Works 194 (including 58 coal and 36 oil) simple Consolidation (2-8-0) locomotives for the Union Pacific, Oregon Short Line, Oregon Railroad & Navigation and Southern Pacific; 12 (10 oil and two coal) simple Atlantic (4-4-2) locomotives for the Oregon Short Line and Southern Pacific; 12 (coal) simple Pacific (4-6-2) locomotives for the Oregon Railroad & Navigation and Oregon Short Line, and 53 (29 coal and 24 oil) simple switching locomotives for the Union Pacific, Oregon Short Line, Oregon Railroad & Navigation, Southern Pacific, Morgan's Louisiana & Texas, Galveston, Harrisburg & San Antonio, and Houston & Texas Central, all for delivery beginning January, 1907. Two sizes of tenders are specified for these locomotives, some being equipped with the larger and some with the smaller size. The specifications are as follows:

General Dimensions.

	Consolidation.	Atlantic.
Type of locomotive	Consolidation.	Atlantic.
Weight, total	208,000 lbs.	196,000 lbs.
Weight on drivers	187,000 lbs.	105,000 lbs.
Diameter of drivers	57 in.	81 in.
Diameter of cylinders	22 in. x 30 in.	20 in. x 28 in.
Boiler, type	Straight top.	
Boiler, working steam pressure	200 lbs.	
Heating surface, total	3,403 sq. ft.	2,649 sq. ft.
Boiler, number of tubes	413	297
" diameter of tubes	2 in.	
" length of tubes	15 ft.	16 ft.
Firebox, length	108 in.	
" width	66 in.	
" grate area	49.5 sq. ft.	
Tank capacity	7,000 and 9,000 gals.	
Coal capacity	10 and 14 tons.	14 tons.
Oil capacity	2,487 & 2,940 gals.	2,487 gals.

	Pacific.	Switching.
Type of locomotive	Pacific.	Switching.
Weight, total	222,000 lbs.	140,000 lbs.
Weight on drivers	141,000 lbs.	.....
Diameter of cylinders	77 in.	51 in.
Diameter of drivers	77 in.	51 in.
Diameter of cylinders	22 in. x 28 in.	19 in. x 26 in.
Boiler, type	Straight top.	
Boiler, working steam pressure	200 lbs.	175 lbs.
Heating surface, total	3,048 sq. ft.	1,557 sq. ft.
Boiler, number of tubes	245	237
" diameter of tubes	2¼ in.	2 in.
" length of tubes	20 ft.	11 ft. 6 in.
Firebox, length	108 in.	
" width	66 in.	40¼ in.
" grate area	49.5 sq. ft.	30.2 sq. ft.
Tank capacity	7,000 & 9,000 gals.	4,000 gals.
Coal capacity	10 and 14 tons.	6 tons.
Oil, capacity	.....	1,020 gals.

Special Equipment.

Bell ringer	U. S. Metallic Packing Co.
Brake-beams	Damascus Brake-Beam Co.
Brake-shoes	American Brake-Shoe Co.
Couplers	National Malleable Castings Co.
Headlights	Handlan-Buck Mfg. Co. and Pyle-National
Injectors	Nathan Mfg. Co.
Journal bearings	Hewitt Mfg. Co.
Piston rod packing	U. S. Metallic Packing Co.
Valve rod packing	U. S. Metallic Packing Co.
Safety valve	Crosby Steam Gage & Valve Co.
Sight-feed lubricators	Nathan Mfg. Co.
Springs	Railway Steel Spring Co.
Steam gages	Ashcroft Mfg. Co.
Steam-heat equipment	Consolidated Car Heating Co.
Tires, driving wheel	Standard Steel Co.

CAR BUILDING.

The Canadian Pacific is having 2,000 freight cars built at its Angus shops.

The Chicago Union Traction has, through its receivers, ordered 200 passenger cars.

The Duluth, Missabe & Northern has ordered 1,900 steel ore cars of 50 tons capacity from the Pressed Steel Car Co.

The Springfield Traction Co. has ordered four 18-ft. car bodies from the American Car Co., for November 25 delivery.

The New York Central Lines, it is reported, will soon consider the purchase of over 20,000 freight and passenger cars.

The Chicago, Milwaukee & St. Paul is building 3,000 box cars of 80,000 lbs. capacity at its West Milwaukee shops. These cars will weigh 40,000 lbs., and measure 40 ft. long, 8 ft. 6 in. wide and 8 ft. 3¾ in. high, inside to car line.

The Texas & Pacific is building 15 standard cabooses of 60,000 lbs. capacity at its Marshall shops. These cabooses will be 29 ft. 2 in. long, 8 ft. 2 in. wide and 6 ft. 9½ in. high, inside measurements. The special equipment includes:

Bolsters	American Steel Foundries.
Couplers	Tower

The Yuet-Han Railway, Canton, China, has ordered from the Wason Car Co., Springfield, Mass., five second class and 10 third class passenger cars, and two baggage cars for December and January delivery. All cars will be 60 ft. over all, wood bodies, and will have Krupp wheels. This order was reported in the *Railroad Gazette* of last week as coming from the Chinese Government.

The Harriman Lines have ordered from the American Car & Foundry Co. 6,000 refrigerator cars of 60,000 lbs. capacity; deliveries to begin next January. The cars will measure 34 ft. 3¼ in. long, inside between tanks; 8 ft. 2¾ in. wide and 7 ft. 6¼ in. high, inside measurements, and 41 ft. 10 in. long over end sills, 9 ft. 1⅜ in. wide over sheathing, and 12 ft. 3⅛ in. high to eaves. The bodies will be of wood and the underframes of steel. Special equipment includes:

Bolster	Truck—Simplex; Body—Commonwealth cast-steel
Brake-beams	Chicago Railway Equipment
Brake-shoes	American Brake-Shoe & Fdry.
Couplers	Climax
Draft rigging	Miner
Journal boxes	National Malleable
Springs	Railway Steel Spring Co.

The Atlantic Coast Line, as reported in our issue of Sept. 14, has ordered 500 double felt lined ventilated box cars of 60,000 lbs. capacity from the Standard Steel Car Co., Butler, Pa. These cars will weigh 38,000 lbs., will be 38 ft. long, 8 ft. 6 in. wide, 7 ft. 5 in. high, all inside measurements, and will have wood bodies and metal underframe. The special equipment includes:

Bolsters	A. C. L. Standard truck
Brake-beams	Pennsylvania Deck Beam
Brakes	Westinghouse
Couplers	Tower
Draft rigging	Farlow, Westinghouse
Dust guards	Harrison
Journal boxes	Symington
Paint	A. C. L. Standard
Roofs	A. C. L. Standard
Springs	A. C. L. Standard

RAILROAD STRUCTURES.

DENISON, TEXAS.—The Missouri, Kansas & Texas is planning to at once begin work on the union passenger station here.

EDMONTON, ALB.—The City Counsel has ratified the Grand Trunk Pacific agreement, which provides that in consideration of a bonus of $100,000, and a right of way into the city, the railroad company will establish its division terminus at this place.

GRAND CROSSING, WIS.—The Chicago, Burlington & Quincy, it is said, has appropriated $25,000 for improvements to its roundhouse here.

LIVONIA, N. Y.—The State Railroad Commission recommends that the West avenue grade crossing of the Rochester division of the Erie be abolished and that a steel bridge be erected north of the present crossing.

OTTAWA, ONT.—Contracts for putting up four of the steel bridges on the eastern division of the National transcontinental railroad (Grand Trunk Pacific) have been let to the Dominion Bridge Co. at $100,000. Contracts for four additional bridges have also been let to the Locomotive & Machine Co. at $60,000.

SPOKANE, WASH.—Announcement is made that the Northern Pacific will spend $500,000 for station and yard improvements here. The company is planning to raise its tracks and depress the streets at crossings within the city limits.

VANCOUVER, B. C.—The Vancouver, Westminster & Yukon will build a drawbridge over the second narrows in connection with the extension of its lines west from Burrard Inlet.

RAILROAD CONSTRUCTION.

New Incorporations, Surveys, Etc.

ATCHISON, TOPEKA & SANTA FE.—See Southern Pacific.

ATLANTA & CAROLINA.—Incorporated in Georgia with $50,000 capital to build a line to be operated either by steam or electric power from Atlanta, northeast via Lathonia, Conyers, Lawrenceville, Hoschton and Jefferson, to Commerce, and from Atlanta southwest via Eastpoint, College Park, Palmetto, Newnan, Moreland, Grantville, Hogansville and La Grange to West Point, approximately 170 miles. The incorporators include M. T. Eggerton and W. E. Woods, of Fulton; L. F. Sell, of Jackson; T. J. Clarke, of De Kalb, and R. W. Tucker, of Rockdale.

BAY POINT & CLAYTON.—Incorporated in California with $150,000 capital, and with office in San Francisco, to build railroads. The directors are H. E. Cowell, E. V. Cowell, S. P. Cowell and W. H. George.

BEAVER CREEK.—It is said that under this name a line is to be built up Beaver Creek in Floyd County, Ky., for a distance of 33 miles. Surveys have been completed and construction work is to be started about the first of October. The office of the company is at Pikeville, Ky.

BOCA & LOYALTON.—See Western Pacific.

CALIFORNIA NORTHWESTERN.—See Southern Pacific.

CANADIAN NORTHERN.—Contract has been given by this company to the Central Contracting Company, of Toronto, to build a line from Nepigon to Lake Nepigon, the work to be completed in one year.

CANADIAN PACIFIC.—The Directors of this road have approved the construction of branch lines as follows: Moose Jaw branch from the main line at Moose Jaw northwesterly, about 50 miles; Weyburn branch, from Weyburn, on the northeastern extension of the Souris branch to Stoughton, on the Arcola-Regina extension of the Souris branch, about 36 miles; an extension of the Stonewall branch from Teulon northerly about 20 miles; West Selkirk branch from Winnipeg Beach to Gimli, about 10 miles; a line from Lauder, on the Souris branch, westerly to Broomhill, about 20 miles, and one from a point near Darlingford, on the Manitoba Southwestern Colonization Railway southerly about six miles.

CENTRAL CALIFORNIA.—See Southern Pacific.

CHICAGO & SOUTHERN TRACTION.—This company has begun operating its line from Sixty-third street, Chicago, via Blue Island and Chicago Heights to Cretè, 25 miles. The company expects to have the line completed through to Kankakee by the middle of October. Arrangements have been made with the Chicago Electric Traction Co. for interchange of traffic.

CLAREMONE RAILROAD (ELECTRIC).—Incorporated in Mississippi to build an electric line from Jackson west to Clinton, and thence to Cooper's Well, 16 miles. The company is planning to eventually extend the line to the Mississippi river, a total distance of 43 miles. The line will cost about $1,200,000 to build and equip. The incorporators are R. K. Jayne and M. Culberson, of Jackson, and M. Walker, of Brandon.

COLCHESTER COAL & RAILWAY CO.—According to report from Parrsboro, Nova Scotia, this company wants bids Sept. 29th for building four miles of railroad from De Bert station to the De Bert coal mine; also for 10,400 sleepers.

CORTLAND & AUBURN.—This company has been incorporated in New York state to build a steam or electric road from Cortland to Auburn, 40 miles. The directors include Chas. B. Wheeler, Brooklyn; N. A. Bundy and Walter L. Webb, Philadelphia; Chas. G. Adams, Auburn. The capital stock is $400,000.

CULLMAN & SOUTHWESTERN.—Incorporated in Alabama, with $500,000 capital, to build a line through the counties of Cullman, Jefferson and Walker, connecting with the Louisville & Nashville at Cullman and the St. Louis & San Francisco at Bryan. The incorporators are William N. Cooke, G. H. Ten Broeck and A. W. Lilliendahl.

DELAWARE & HUDSON.—This company is securing land for straightening and double-tracking its line from Schenectady to Delanson, 15 miles. The work includes two large new freight yards.

EAST ST. LOUIS, COLUMBIA & WATERLOO.—Incorporated in Illinois with $10,000 capital to build a line from East St. Louis, Ill., south to Waterloo on the Mobile & Ohio, about 25 miles. The incorporators are J. W. Rickert and J. J. Koenigsmark, of Waterloo; H. Reichenbach, J. Warnok and E. F. Schoening, of Columbia.

FRONT ROYAL, RAPPAHANNOCK & TIDEWATER.—An officer writes that plans are being made for starting a preliminary survey for this proposed road, to be built from Front Royal, Va., on the Southern, south through Chester's Gap, Rappahannock County, and Washington Court House, to Sperryville, 23½ miles. As soon as surveys are completed, contracts are to be let for building the line, which is to be financed by Philadelphia and New York capitalists. The work will not be difficult, and will be mostly side cutting, with 2 to 2½ per cent. grades, some short bridges and a few trestles, but no tunnels. The company on the completion of the above work is planning to continue the line south through Madison County, to Orange and to tidewater. S. R. Millar, of Front Royal, is President. (Aug. 31, p. 58.)

GAINESVILLE & GULF.—An officer writes that under the name of the Tampa & Jacksonville this company will build a line from Jacksonville via Gainesville to Tampa, Fla. Contracts have been let to the American Construction Co., of Gainesville, for the work, and it is now under way. A sub contract has been given to W. H. Jones for grading 53 miles of the line. There will be two steel bridges. (See Tampa & Jacksonville, Sept. 7, p. 64.)

GEORGIA ROADS.—An application will shortly be made for a charter by a company to build a line from Social Circle, which is on the Georgia and the Monroe railroads south about 10 miles to Mansfield on the Central of Georgia. The company, it is said, is planning to use the old Middle Georgia & Atlanta grade between these two points. The project is being promoted by Colonel J. N. Preston and Captain A. W. Roberts, of Atlanta, and T. A. Perry, of Decatur.

GREAT NORTHERN.—It is said that a branch is to be built at once by this company in Washington. It is from a point near the Nighthawk mine to the foot of Palmer Mountain, northeast of Spokane, 5 miles, and is to develop ore properties.

GREENVILLE & ROLLINGFORD (ELECTRIC).—Incorporated in Mississippi to build an electric line from Leland through Greenville and Rollingford. G. B. Vincent and Van B. Boddie are incorporators.

HAMPSHIRE SOUTHERN.—Incorporated in West Virginia with $30,000 capital to build a line from Springrun, in Hampshire County, southwest via Romney, where the head office of the company will be located, through Hardy and Grant counties to Durbin and to a connection with the Chesapeake & Ohio and the Western Maryland in Pocahontas County. It is said that contracts for building the road will be let shortly. The incorporators include: John T. McGraw, of Grafton; J. J. Cornwell, of Romney, and W. B. Cornwell, of Fairmont.

INTERCOLONIAL.—Announcement is made by Hon. H. R. Emerson, Minister of Railways, that the double-tracking of this road from St. Johns, New Brunswick, east, is to be begun next spring.

LEWISTON & SOUTHEASTERN (ELECTRIC).—A contract is reported let by this company to the Scofield Co., of Philadelphia, to build 100 miles of its line between Lewiston, Idaho and Grangeville. (See Construction Record.)

MOBILE & WESTERN.—Incorporated in Alabama with $100,000 capital to build a line from Mann's station, on Mobile Bay, south of Mobile, west to the Mississippi river. R. K. Mann, of Muskegon, Mich., is President; G. Watwood, of Mobile, Vice-President and General Manager, and W. H. Mann, of Elkhart, Ind., Secretary and Treasurer.

MORELIA & TACAMBARO.—This company will have completed by November 1 the first section of its line from Irapuato, state of Guanajuato, Mexico, which is on the Mexican Central, south to Puruandiro, 55 miles. The road is projected further south to Ariro, and it will be 200 miles long. The company has been granted concessions, rights of way and terminals by the Mexican Government. (Aug. 24, p. 51.)

NATIONAL OF MEXICO.—This company, which is owned by the Government, is preparing to make direct connections with all the chief centers in Mexico City in addition to the belt line which it is building around that city. The Government has granted permission to build these lines.

OAK POINT & ELYRIA.—Incorporated in Ohio with $300,000 capital and office at Elyria to build railroads. The incorporators include A. R. Mannering, E. S. Cooke and F. S. McGowan.

OREGON & WASHINGTON.—Surveys are being made and rights of way secured by this company for its proposed line from Portland, Ore., north to Everett, Wash., about 189 miles. It is said that the money for carrying out the work has been secured. (June 22, p. 168.)

OREGON WESTERN.—See Southern Pacific.

OSCEOLA, LITTLE RIVER & WESTERN.—This company, now building a line from Osceola, Ark., on the St. Louis & San Francisco, west to Little River, 15 miles, has completed five and a half miles, which is being used for logging purposes. J. E. Roberts, of Osceola, is Chief Engineer.

ST. LOUIS, LAKEWOOD & GRANT PARK (ELECTRIC).—This company has filed a mortgage securing bonds to the amount of $300,-

000. The money is to be used in completing the line from the terminus of the Southampton line of the United Railways Co. in St. Louis to the Grant Farm.

Salina & Northwestern.—Incorporated in Kansas by residents of Topeka to build a line from Salina, Kan., northwest to Kearney, Neb., about 200 miles. This is thought to be a project of the Union Pacific to connect its Kansas and Nebraska divisions through territory now occupied by the Burlington.

San Francisco & Northwestern.—See Southern Pacific.

San Juan.—According to reports from Oaxaca, Mex., this company is building a line which it expects to open for passenger traffic from Oaxaca to Taviche October 15. This road connects with the Zimitlan Railroad at San Pablo. The company will eventually extend the line to Tlacolula with branches to mines.

Sierra Pacific.—This company has applied for incorporation in California with $1,500,000 capital. The company is planning to build a line from Springville, Tulare County, southwest to Port Harford, San Luis Obispo County, on the Pacific coast, via Globe, Hutton, Coalinga, Paso Robles, Templeton, Santa Margerita and San Luis Obispo. The company is also planning to build a number of short lines as feeders at different points in the valley. The names of the promoters are not given.

Southern Pacific.—An officer writes that this company, under the name of the Oregon Western, is grading its proposed line from a point on its line at Drain, Ore., west via Elkton and Scottsburg, thence southwest to Marshfield on the Coose Bay, Roseburg & Eastern. No track has yet been laid. (Aug. 24, p. 51.)

The Central California, of which Manager E. E. Calvin, of the Southern Pacific, is President, announces its intention to build a line from Niles, Cal., to Dumbarton Point and thence to Redwood City and San Mateo instead of starting from the present Southern Pacific line at Newark as originally intended. The proposed new link, which is to be 30 miles long, is intended as a cut-off to facilitate the transfer of freight across the bay at San Francisco.

Both this company and the Atchison have been making surveys in Humboldt and other counties in California with a view of starting work early next year on a joint line to connect Eureka with San Francisco. The existing road, the California Northwestern, from San Francisco north to Willits, 115 miles, is to be utilized, and the remaining gap of about 150 miles to Eureka will be completed by building a joint line by the shortest practicable route to Camp Five, the southern terminus of the short road now operated by the Atchison under the name of the San Francisco & Northwestern, which runs from Arcata south via Eureka to Camp Five, 42 miles. Construction work on this line was to have been started the past summer, but the plans were all destroyed by the great fire in San Francisco.

This company has petitioned the Board of Supervisors for authority to build spur tracks along the northern city front of San Francisco. This would be an extension of the present Belt line, owned by the state, and under the control of the State Board of Commissioners. The plans cover about one-third of the water frontage of the city.

Tampa & Jacksonville.—See Gainesville & Gulf.

Veblen & Northwestern.—This company has completed grading its line from the northeast corner of South Dakota at Veblen east through Roberts County to Minnesota, 32 miles. The company was organized about two years ago by farmers of this section. M. J. Hawley, of Brandt, S. Dak., was President and principal promoter of the project.

Virginia & Truckee.—See Western Pacific.

Western Pacific.—An officer denies that this company has bought the Boca & Loyalton. San Francisco press despatches state that the Western Pacific has acquired control of the Virginia & Truckee, which runs from Reno, Nev., on the Southern Pacific, to Carson City, 31 miles.

West Penn Railway Co. (Electric).—This company, which operates 94 miles of electric roads in Pennsylvania, has opened a new line from Mount Pleasant, Pa., via Hecla to Greensburg, 14 miles.

White Top.—Incorporated in Virginia with $50,000 capital, and office at Azen, to build a line from Grassy Ridge, Washington County, to Upperford on White Top, Laurel, Smith County; also from Grassy Ridge to Blevins Gap, Grayson County. W. A. Hassenger, of Lamona, is President, and J. L. Hurt, of Abingdon, Secretary. R. M. Page and G. E. Barnes are among the incorporators.

RAILROAD CORPORATION NEWS.

Baltimore & Ohio.—Kuhn, Loeb & Co., of New York, announce that negotiations are pending for the purchase from them by the Union Pacific of the 400,000 shares of Baltimore & Ohio stock, recently bought by Kuhn, Loeb & Co. from the Pennsylvania. See editorial columns.

Canadian Northern.—This company, which recently bought the Qu'Appelle, Long Lake & Saskatchewan, will not begin the operation of it until June, 1907, the Canadian Pacific having a lease on the road until that time.

Canadian Pacific.—See Canadian Northern.

Central New England.—See New York, New Haven & Hartford.

Chesapeake & Ohio.—This company has issued $2,900,000 additional 4 per cent. equipment trust notes secured on 3,000 steel gondola cars bought from Blair & Co. They are payable in 20 semi-annual instalments, beginning Dec. 1, 1906.

Chicago, Rock Island & Pacific.—This company has declared a dividend of 2 per cent. on its $74,842,600 outstanding capital stock. Three months ago 1 per cent. was paid on this stock. The annual rates in previous years have been as follows: 1905, 6¼ per cent.; 1904, 8¼ per cent.; 1903, 7½ per cent., and for the four preceding years, 5 per cent.

Cleveland & Pittsburg.—The New York Stock Exchange has listed $1,218,200 additional special guaranteed betterment stock, making the total amount listed $7,477,800. The new stock represents new equipment, second track, sidings, right of way, station grounds and other improvements.

Cleveland, Cincinnati, Chicago & St. Louis.—At a meeting of the directors held on Sept. 19 it was recommended that the authorized capital stock be increased from $40,000,000 to $50,000,000. The proceeds of the sale of the new stock are to be used for equipment and betterments. The authorized capital stock was increased from $28,700,000 to $40,000,000 thirteen months ago.

Colorado & Southern.—See Rock Island Company.

Consolidated (N. Y., N. H. & H. Electric Lines).—See New England Investment & Security Co.

Iowa Central.—See Rock Island Company.

Lehigh Valley.—Gross earnings of this company for the year ending June 30, 1906, were $32,789,857, an increase of $1,514,014. This showing, which is not particularly favorable when compared with the average increase of other roads, is partly due to the decrease in the earnings from coal traffic, owing to the strike in April and May. The net earnings were $12,637,646, an increase of $219,505. The surplus after charges was $5,451,584, an increase of $58,695. The Lehigh Valley Coal Co. shows a net income of $318,489, a decrease of $317,059.

New England Investment & Security Co.—The capital stock of this new holding company for the Consolidated's lines in Massachusetts is $20,000,000, instead of $2,000,000, as reported in our issue of last week. Half of this capital is preferred stock.

New York Central & Hudson River.—At a meeting of the directors held on Sept. 19, the issue of $29,839,560 additional capital stock, the proceeds to be used for improvements, was authorized. The authorized capital stock is $250,000,000. The new issue will bring up the amount outstanding to $179,282,060. The new stock will be issued to stockholders at par at the rate of 20 per cent. of their present holdings.

New York, New Haven & Hartford.—This company has discontinued the operation of trains between Hopewell, N. Y., and Fishkill Landing, but the line to Fishkill Landing will be kept in operation by the Central New England.

Northern Pacific.—During the two months ending August 31, the gross earnings of this company were $11,370,418, an increase of $1,958,963, or 21 per cent. The greatest increase was in freight earnings, 29 per cent. The proprietary lines of the system earned $201,166, an increase of $47,603, or 31 per cent.

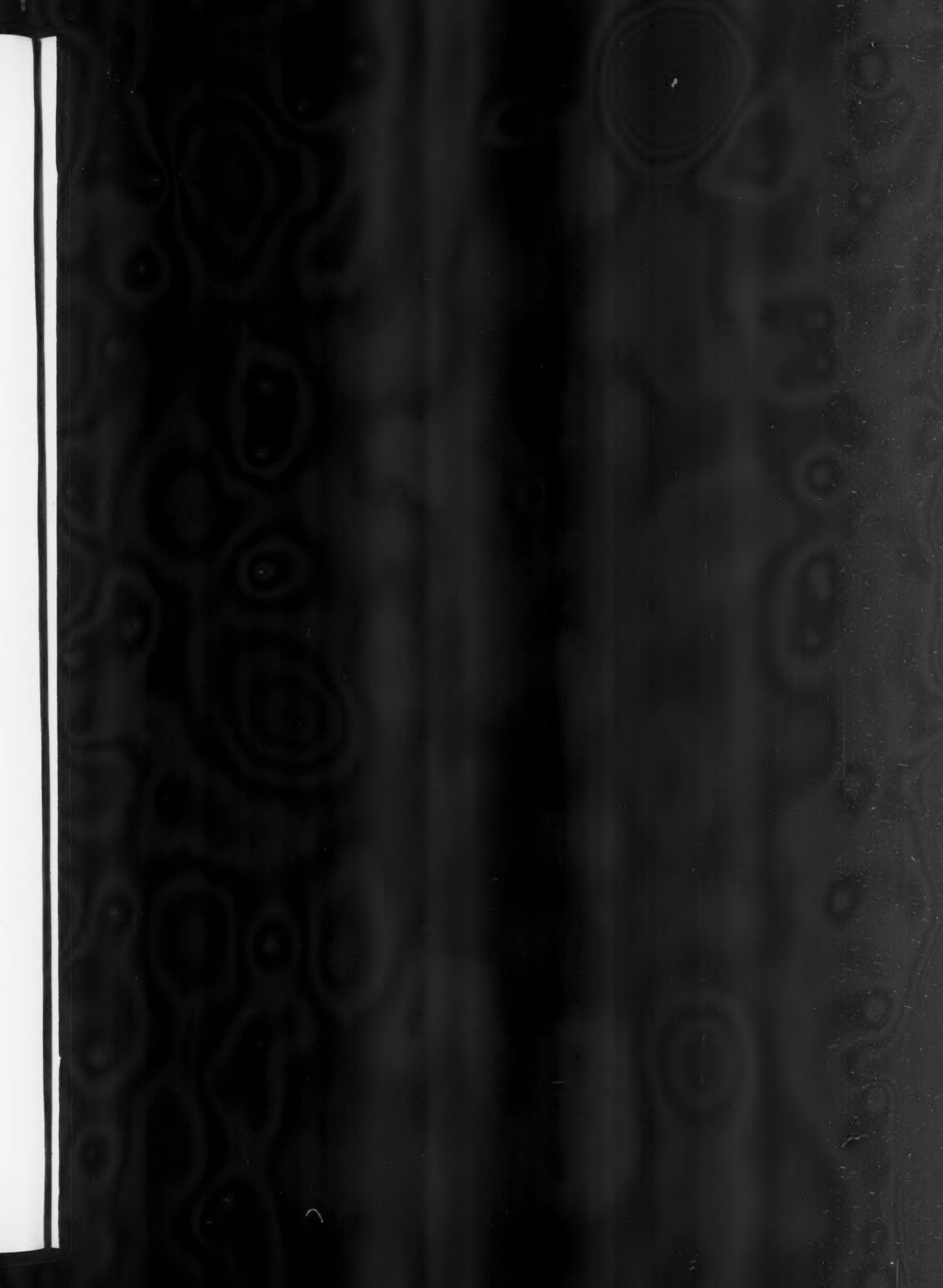
Pennsylvania.—See Baltimore & Ohio.

Qu'Appelle, Long Lake & Saskatchewan.—See Canadian Northern.

Rock Island Company.—It is reported that interests identified with this company have bought from Edwin Hawley his holdings in the Colorado & Southern and the Iowa Central.

Rumford Falls & Rangeley Lakes.—Gross earnings for the year ended June 30, 1906, were $152,449, an increase of $20,023; net earnings, $64,301, an increase of $20,474. Surplus after charges, $8,738, an increase of $781.

Union Pacific.—See Baltimore & Ohio.

Velasco, Brazos & Northern.—This 20-mile road in Texas has been ordered to be sold under foreclosure on October 2d. It was sold to H. C. Alexander on July 3d for $80,000, but the sale has been set aside.

White River Valley.—This road, which runs from Bethel, Vt., to Rochester, 19 miles, has been ordered closed by the Vermont Railroad Commission, being considered unsafe for traffic.